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QUARTERLY

OF THE

National Fire Protection Association

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National Fire Protection Association.

Executive Office, 87 Milk Street, Boston, Mass.

Active Members.

July, 1916.

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American Institute of Consulting Engineers.
American Institute of Electrical Engineers.
American Institute of Mining Engineers.
American Gas Institute.
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National Automatic Sprinkler Association.
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National Commercial Gas Association.
National Convention of Insurance Commissioners.
National Electrical Contractors' Association.
National Electric Light Association.
National Founders' Association.
National Gas Engine Association.
National Implement and Vehicle Association.
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Ohio State Fire Prevention Association.
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Underwriters' Association of New York State.
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Underwriters' Laboratories.
Vancouver Island Fire Underwriters' Association.
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Western Canada Fire Underwriters' Association.
Western Factory Insurance Association.
Western Insurance Bureau.
Western Improved Risk Association.
Western Sprinklered Risk Association.
West Virginia Inspection Bureau.
Wisconsin Inspection Bureau.
Wisconsin State Fire Prevention Association.

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Reports on fires appearing in the Quarterly are copies of or extracts from written reports forwarded to the Association. This Association, as a body, is not responsible for the statements or opinions of any of its members.

I have ten little toes
That are all in place;
I have one little nose
That is on my face.
My fingers are still
Where they ought to be
And there's nothing at all
The matter with me.

My thumbs and ears
Are as good as new
So I'll give three cheers
And a tiger, too!
I can dance and sing,
I can shout with glee,
For there's not a thing
The matter with me.

- S.E. Kiser. -

A JULY 5th INVENTORY

Unofficial reports indicate that Independence Day, 1916, was the sanest July 4th since records were kept.

The public needs to be *reminded* as much as it needs to be *informed.*

The Quarterly

Vol. 10. July, 1916 No. 1

The Twentieth Annual Meeting. The published *Proceedings* of the Twentieth Annual Meeting mailed to members in June contains between its covers more matter of absorbing interest than any previous volume of the series. It was said of Mr. Gladstone that he made the British budget as interesting as a popular novel. Our members themselves without the deliberate purpose of the great English statesman almost succeeded this year in doing this for the record of our annual meeting. The subjects themselves had of course something to do with it, and the presence of women as speakers heightened the interest. The meeting illustrated how much our members may have to talk about in a year when the volume of technical work is light enough to permit leisurely discussion. The annual resolutions or "platform" which is usually adopted without debate was this year discussed in almost every feature and subsequently called forth the remark from a past-president that he had never heard a more forceful, scholarly and competent discussion of a subject on the floor of the Association. An architect from the South who came in the first afternoon to hear the papers on the protection of school houses, remained throughout the three days absorbed in new impressions. He remarked that if our presiding officers were typical of the calibre of our membership he had been missing something. The Association has previously been complimented upon the character of the members who have presided over its sessions. This year, not to mention the quiet, effective and well-balanced service of President Meek whose abilities the members had their first real opportunity to appreciate, the gavel was held in succession by Mr. Evans, Mr. Kohn, Mr. Cabot, Mr. Humphrey, Mr. Merrill and Mr. Wiederhold; a list of men of such exceptional endowments as to crowd any other American association pretty hard to match.

The papers of Mr. Ittner, Mr. Snyder and Mr. Challman on the subject of safeguarding the lives of school children, and the discussion that followed their presentation, furnished for our records information of great value which the Executive Office will issue in pamphlet form. Miss McDowell's address on fire prevention and juvenile workers was received

with warm commendation, and the discussion on the protection of high value districts led by Mr. Blauvelt, Mr. Ekern and Mr. Forster greatly pleased the old members of the Association.

The committee reports, while not as voluminous as in late years, were of an interesting sort and most of them had been printed in advance, thus permitting prompt disposition. The committee on *Signaling Systems* presented a revision of the *Suggestions for Protection against Lightning* which was capably defended by Mr. Dana Pierce, the chairman being absent. Mr. Lacount reported for the committee on *Hydrants and Valves* good progress in the production of specifications for *Indicator Posts* in which the co-operation of the manufacturers had been secured. Professor Woolson's committee on *Fire Resistive Construction* still further developed its plan by bringing in specifications for a Grade "A" office building. Mr. Richards of the committee on *Manufacturing Risks and Special Hazards* presented the text for a pamphlet covering suggestions for the elimination and protection of *Structural Defects*, intended to replace certain sections of the Association's old pamphlet *Uniform Requirements* once published by the National Board of Fire Underwriters but now out of print. Mr. Booth's committee on *Automobile Fire Apparatus* presented specifications for two types of gasoline driven units, a *Combination Chemical Engine and Hose Wagon* and a *Combination Service Ladder Truck*. Mr. Teague's committee on *Standardization of Pipe and Pipe Fittings* showed excellent accomplishment in this new field and its report was appreciatively received. The committee on *Automatic Sprinklers* gave a good account of its excursion into the field of *Dry Pipe Systems in Refrigeration Rooms*, Mr. Scofield's painstaking labors in the preparation of the report of his committee being evident. Mr. Forster's committee on *Safety to Life* checked up its previously presented topics, *Sprinklers as Life Savers* and *Outside Stairs*, and introduced the new and difficult subject of *Stair Requirements for Buildings*. The committee on *Explosives and Combustibles*, administered during the year by Chairman Stewart of the Executive Committee, gave evidence of hard work in its general revision of the *Regulations for Acetylene Gas and Storage of Calcium Carbide* and its proposed amendments to the regulations for *Internal Combustion Engines*, *Fuel Oil Storage and Use* and *Containers for Hazardous Liquids*. Favorable action was taken upon all of these various reports although certain details of several of them were referred back to the committees for further consideration before adoption by the Executive Committee.

* * * * *

Increase in Membership Dues. There was but little objection to the recommendation of the committee on *Articles* for an increase of dues of members to $30 and associate members to $6. Since the creation of the Associate class a dozen years ago no increase of dues has ever been made, although the privileges and value of the membership have doubled. It is hoped by the executives that no further increase will ever be necessary and that the revenue derived from a growing

membership will cover our expanding needs. There is no doubt that many of our old active members would cheerfully pay fifty or even one hundred dollars per year dues if it seemed best to make such an increase, but the executives realize that we have in our membership a number of engineering organizations whose struggle for sufficient funds to meet their needs is as great as our own. The objection raised in the discussion of this matter to the effect that the greater privileges afforded members in the way of additional publications would operate to deplete our associate membership has not yet been realized. On the contrary the week after the dues of associate members were increased by the Association from $5 to $6 our member the Underwriters' Laboratories, applied through its president, Mr. W. H. Merrill, for fifty associate memberships for the home and branch office staff of that organization. Following this generous and appreciative action on the part of President Merrill of the Laboratories our member Frank E. Henderson, Chief of the St. Louis Fire Department, put thirty engine houses of that city into our associate membership, the firemen of each company chipping in to make up the house membership. St. Louis is therefore the first American city moving to place the literature of the N. F. P. A. regularly before the rank and file of its fire fighters.

* * * * *

"Gimbel Brothers" Capitulates. President Meek said some graceful things about Mr. Powell Evans of Philadelphia in introducing Mr. Evans to preside at a session of our annual meeting, referring to him as a man who fearlessly attacks entrenched wrong. Mr. Evans has certainly plucked a laurel in the outcome of his fight to compel the Philadelphia department store, "Gimbel Brothers," to safeguard its employees' and customers' lives against a possible flash fire. This was Mr. Evans' fight. He originated it; he waged it; he financed it. First he urged the Gimbels to act, for their own good and that of the common safety; then he urged the merchants on every side of the big store (who were paying insurance superpremiums because of it and in danger of conflagration) to move in their own defense. Many feared their big rival and preferred to remain supine. Mr. Evans then appealed to the Philadelphia newspapers; but the Gimbels advertise in the Philadelphia newspapers. What was the safety of the city compared to the Gimbels' monthly check? Mr. Evans then, as chairman of the Insurance Committee of the Chamber of Commerce, took up the fight openly on the floor of the Chamber. Against every influence open and hidden, he turned his guns and finally overcame the local official inertia and induced the authorities of Philadelphia to bring suit on behalf of the city, by appointing a leading Philadelphia lawyer special assistant city solicitor secured by Mr. Evans himself. Then came the organization of the Bryn Mawr Fire Prevention Study and Mr. Evans interested that fearless band of highly educated, competent women in his fight. On May 11th the whole matter was presented to the N. F. P. A. by Miss Leila Houghteling of Bryn Mawr (see *Proceedings* annual meeting) and on June 5th

the Gimbels capitulated. At a conference on that day two of the Gimbels, their builder, their insurance agent and their attorney met Mr. Alexander Simpson, Jr., Special Assistant City Solicitor of Philadelphia; Mr. Forster, another assistant; Mr. Wm. A. Schnader, Special Counsel for the Bryn Mawr Committee; Mr. Evans, Chairman of the Insurance Committee of the Chamber of Commerce; Mr. Clark, Chief of the City Bureau of Building Inspection; Mr. Elliot, City Fire Marshal, and Mr. Hexamer of the Philadelphia Board of Fire Underwriters, and gave in and abandoned their position agreeing rather than defend the City suit to make the substantial corrections called for.

The firm agrees to erect two fire walls, running north and south, the full length of the building, dividing it into three sections, with automatic fire doors. Under the agreement the defendants will erect at the openings in the "L" portion of their building iron shutters. The minor details of all this work will be adjusted by the Bureau of Building Inspection and the engineer of Gimbel Brothers.

The cost of the two fire walls and the other work will entail large but reasonable expenditure considering the results secured to all concerned. The work is to be started not later than July of this year.

Mr. Evans after months of intense personal effort and an incredible expenditure of day and night hours may now for a time turn to occupations more profitable to himself. No one can know the real value of his untiring public service or how great the disaster he may have averted from his city by laying his resources and fine talents upon the altar of the common need. His city will naturally promptly forget his service, but a few choice spirits will remember; the few who look upon courageous, disinterested action as the finest thing in life.

* * * * *

Public Indifference Before and After. If the elimination of such individual and community hazards as those existing in Gimbels' department store requires the long and tireless effort of a determined citizen of more than average weight and influence in a community, what power for good is the ordinary vehicle of public persuasion? Public indifference before a holocaust is little less than public indifference after. The *Pittsburgh Post* has this to say in a recent editorial:

> The loss of thirteen lives in the box factory fire on the Northside October 25 last was scarcely more of a shock to the community than the shameless announcement of District Attorney Jackson yesterday, six months after the disaster, that he has done nothing to bring to justice those responsible for the tragedy.
>
> Soon after the fire the coroner caused the arrest of officers of the Union Paper Box Company and the James Brown estate, owner of the building, who are under heavy bond for further action. The coroner's jury, after a thorough hearing, with an attorney engaged specially for the occasion by the county commissioners aiding in bringing out the facts, recommended that the box company and the estate owning the building be held to await the action of the grand jury upon a charge of negligence. Then was the time, in a case of such magnitude as this, for the district attorney to secure any corrections he considered necessary. His raising doubts at this late day is remarkable. Because the recommendations of the jury did not name the officers of the concerns Jackson says he has no authority to proceed — he cannot indict a company or an estate. This strikes us as a mere technicality in this instance. The

common understanding is that so far as a legal proceeding is concerned, a coroner's procedure is entirely a matter of form. Failure to include the names of the officers of the company and the estate mentioned in the recommendations of the jury certainly did not relieve the officers of any liability they had incurred under the law — and they are under bond to answer.

After six months, who knows of anything done by the city, following the disclosure of negligence on the part of its officers entrusted with enforcement of the laws for safety? What have any of the authorities done to guard against a repetition of the horror, which claimed the lives of twelve young girls and one man, and caused injuries to many others? Is this deadness of sensibilities on the part of the public officers but a reflection of deadness on the part of public sentiment? If not, there is but one way to prove it.

Let some of the organizations that showed such keen sorrow on the death of those young girls call a mass meeting without delay to find out how enforcement of the law can be brought about.

Six months gone by and the box factory case not even presented to the grand jury!

How to enforce the law! That seems to be the problem. Men in political life wait before acting for public sentiment to declare itself, and the public is a somewhat vague body made up of individuals who are engrossed in personal things, and who move generally only when their private comfort or economic interest is menaced.

* * * * *

Dwelling House Fires in the South. Our New Orleans member Mr. J. G. Pepper advises that considerable concern is being felt throughout the South over the large number of dwelling house fires. Mr. Pepper states that some insurance companies have eliminated tenant dwellings; others have aimed their prohibition toward mortgaged dwellings; while others are now objecting to non-standard flues, etc. There is no doubt, however, that the main cause for the bad record can be attributed to moral hazard first, with shingle roofs and bad flues a close second.

Commenting on this situation the *Western Underwriter* says:

There is, perhaps, no one cause that is responsible for the excessive loss rate, but altogether there are a number of factors that enter.

In the first place southern dwellings are not built, for the most part, on solid foundations as they are in the north. They are set on piles or other wooden supports so there can be circulation under the house to keep it cool. In other words, in the south the residences are built with the idea of having the interior as cool as possible, while in the north they are built with the object of warmth.

The open fireplace in so many rooms in a southern home is also a prevalent cause of loss. Where wood is not burned, householders use a low grade of coal which cracks and throws out particles of fire. The construction is largely of southern pine, which is very inflammable.

Another cause for dwelling fires is the fact that but few houses are plastered. The price of lath is high and hence a kind of canvass is tacked over the studding and supports. This is painted and on it is pasted the wall paper. Between this paper and the exterior there is open space. This acts as a flue in case of fire.

Altogether the southern house is very inflammable and when a fire is started it goes in a flash. Negro help, no doubt, contributes to some extent in the way of carelessness and shiftlessness. Then in most of the southern states during the summer season, when the weather is hot, the house is thoroughly dried out and that makes it even more inflammable.

There are few partial losses on southern dwellings. When a fire gets started it means a total loss. There is no time to get furniture out because the whole structure

is almost as inflammable as celluloid. In other sections of the country, where houses are more substantially constructed, the total loss is an exception. There is usually opportunity for getting out household furniture and belongings for the fire is not so readily spread in a short time.

* * * * *

Fire in Leather Dust. Notes on a rather unusual fire reach us at the hands of Mr. George W. Booth, from Assistant Fire Chief Soulé of Coatesville, Pa.

The fire occurred in a shoe repair shop, where shoe machines do the polishing, etc., by means of rapidly revolving drums covered with emery or sand paper, the resultant dust from the leather being blown by a fan through a pipe extending down through the floor of the shop onto the ground, under the floor. The shop is of frame construction, on joists on stone foundations, the joists being about six inches above the ground. Fire occurred in the morning when smoke was discovered coming up through the pipe-opening in the floor. The leather dust was about three inches thick on the ground and in quite a few places was like a glowing coal, incandescent, without flame.

Buffing machines have cloth wheels by which shoes are polished after repairs are made. A great deal of lint comes from these wheels and this is mixed with the dust. Knives are also sharpened on the emery or sand paper buffing wheels. There was absolutely no way in which fire could get to the dust under the floor unless carried there in the shape of sparks from the machines. On examination at the time of the fire, Assistant Chief Soulé found the mass on the ground dotted all over with lumps of glowing dust resembling lumps of incandescent charcoal. These lumps or balls could be picked up without falling apart, when handled gently.

* * * * *

Rebuilding Ottawa's Parliament Buildings. The week after the fire in the Parliament building at Ottawa architects began work on plans for remodeling the damaged structure. As was soon announced, the new plan preserves intact the present facade, and the remodeled buildings will preserve the present architectural scheme in full. It not only preserves the scheme, but improves upon the design of the actual building, for it calls for the tearing down of the new west wing, built in 1909, which was untouched by the fire. This wing is not in harmony with the original design, but the new three-story wing will be in conformity to the demands of architectural harmony. The rear elevation of the entire building will be raised to correspond with the front elevation. The greatest changes will be in the interior, where they were most needed, for the sake of both convenience and safety.

The Parliament buildings at Ottawa have been so generally admired that it is interesting to note that the young English poet, Rupert Brooke, in his "Letters from America," speaks somewhat slightingly of them. He observes that they "were put up in the middle of the last century — an unfortunate period." "But," he adds, "they have dignity, especially of line; and when evening hides their colour, and the western sky and the

river take on the lovely hues of a Canadian sunset, and the lights begin to come out in the city, they seem to have the majesty and calm of a natural crown of the river-headland." It cannot be doubted that Brooke's natural taste was classical, and it may be that he did not respond warmly to the Gothic design.

* * * * *

The Grocers and the Credit Men. Through the indefatigable efforts of our Pittsburgh member Mr. D. C. Shaw, whose fellow officers of the National Wholesale Grocers' Association familiarly call "Old Fire Waste", it is more than probable that the Grocers' organization at the meeting of its executives this fall will adopt Mr. Shaw's suggestion and create a special committee on fire prevention. The ready response by this Association to the resolution offered at its convention this year advocating assessing the cost of extinguishing fires upon those disobeying fire prevention orders is another indication of Mr. Shaw's labors among his fellow business men in the wholesale grocery trade.

Simultaneously with the Wholesale Grocers' Convention in Boston our other valued member the National Association of Credit Men was holding its annual convention in Pittsburgh. The work of the Credit Men in fire prevention is already so well known that it is merely necessary to refer to the report of its Committee on Fire Insurance this year. Special emphasis was placed in this report upon the hazards of the wooden shingle. At the conclusion of the report the committee offered a resolution which was unanimously adopted by the convention. The resolution is perhaps one of the most interesting and significant ever adopted on the question of the fire waste by a commercial organization. It is as follows:

Resolved, That we here reaffirm the resolutions adopted at previous conventions calling for the appointment by our local associations of *fire insurance committees*, it being the conviction of this association that the credit men of the country should carry on systematically, and as a regular part of association work, the study of conditions in their respective communities with reference to the fire hazard, and interest themselves in the improving of building codes and regulations in their cities, demand such protective agencies as fire department inspection, endeavor to arouse public opinion to the end that fire marshal and department orders for changes looking to the lessening of hazards shall be promptly heeded, endeavor to educate members and business men generally in the matter of providing themselves in plant and home with that which will extinguish incipient fires, and, finally, establish that orderliness and freedom from accumulations of filth and rubbish, which so frequently become the seat of fire.

Resolved, That the incoming committee on fire insurance be asked by this convention to give special attention to the conflagration hazard of the untreated wooden shingle, as also to the part the ordinary frame dwelling within the limits of our cities has played in feeding the fire fiend, and work in co-operation with technical and general business organizations for the improvement of the conflagration hazard in the two respects named.

Resolved, That the association continue to stress the necessity of bringing about a better understanding between the public and fire insurance companies to the end that there be established a basis of cordial co-operation between them in bringing about proper regulation of fire insurance companies, as also in developing general interest in fire prevention, and, further, that every effort be made to prevent the enactment of laws which impose an unfair and uneconomic burden upon companies, tending thereby to restrict the supply of sound insurance.

Membership Notes

Members in all parts of the U. S. co-operated this year as usual in the circulation of the Association's Independence Day bulletin. Manager Clem E. Wheeler of the Wisconsin Inspection Bureau distributed ten thousand copies in Wisconsin. The newspapers generally report a "safe and sane" day, but later reports may modify this. New York had thirty fires against last year's twenty-four. Milwaukee had six, while ten years ago she had thirty-two. San Francisco had fifty-six, reckoned the worst Fourth of July since 1905.

* * * * *

The state of Ohio now has two distinguished advocates of co-operative associations to further the adoption of the national standard hose coupling

and hydrant fitting; the Ohio State Fire Prevention Association and the Cleveland Chamber of Commerce. Following the lead of the co-operative association of Central Ohio Fire Chiefs organized for this purpose in Columbus, the co-operative association of Northeastern Ohio Fire Chiefs has been organized. The Public Safety Committee of the Cleveland Chamber of Commerce promoted this organization, the officers of which are the fire chiefs of Mansfield, Cleveland, Youngstown, Lorain, Elyria and Painesville, Ohio.

* * * * *

An interesting feature of the annual convention of the National Association of Credit Men at Pittsburgh last month was the address by Ira G. Hoagland on "The Responsibilities of Business Men for the Decrease in Fire Waste". That Mr. Hoagland had a sympathetic audience for his address is sufficiently indicated by the character of the report of the Fire Prevention Committee of the Credit Men mentioned in the editorial columns of this issue.

* * * * *

An interesting lecture tour was recently arranged by our member the Texas State Fire Insurance Commission for Mr. A. O. Boniface of Underwriters' Laboratories. In its work in Texas cities the Commission has undertaken several lines of public education. Engagements were made for Mr. Boniface by the chief engineer of the Commission in the motion picture houses of the larger cities of the state where Mr. Boniface delivered his lecture on fire prevention and protection and exhibited the motion pictures of the Laboratories and its work. Probably the largest audience was at Houston, the result of novel advertising by Fire Chief Seider who ran his big aerial truck with advertising streamers on its side through the main streets of the city, the great siren being blown continuously.

* * * * *

Mr. Sidney J. Williams of the State Industrial Commission of Wisconsin, a member of our Executive Committee, addressed the members of the Wisconsin Fire Prevention Association at its quarterly meeting at Green Lake, Wis., recently, describing the work of the Commission in co-operating with fire prevention effort.

* * * * *

Frank Irving Cooper of Boston recently addressed the Congress of the American School Hygiene Association at the rooms of the Russell Sage Foundation. Mr. Cooper has been active in the work of the N. F. P. A. in relation to the safeguarding of schools.

* * * * *

The Bureau of Combustibles and Fire Risks, Newark, New Jersey, C. Albert Gasser, Chief, has adopted a plan of showing the fire statistics of Newark diagramatically. The relation of the number of fires to occupancies, the kind of building, fire causes, ratio of loss, etc., are thus shown. Samples will doubtless be sent by Captain Gasser to members who care to write for them.

Members will regret to learn of the death of F. H. Porter of San Francisco, for many years manager of the Fire Underwriters' Inspection Bureau. Mr. Porter was originally from New England, a direct descendant of John Howland, one of the Mayflower colony. He was a devoted member of the N. F. P. A. and crossed the continent every year to our annual meetings.

* * * * *

The Province of Saskatchewan, Canada, has amended its fire prevention act to require the investigation of the origin and circumstances of every fire with a special view of ascertaining if such fire is the result of negligence, carelessness, accident or design. Our Canadian members in the great Northwest are leaders in this direction.

* * * * *

Secretary Wentworth addressed the annual convention of our member the National Lumber Manufacturers Association in Chicago on June 1st, and the annual convention of our member the National Wholesale Grocers' Association in Boston, June 15th, presenting at both the N. F. P. A. resolutions declaring for the fixing of the cost of extinguishing fires upon those disobeying or ignoring fire prevention orders. The resolution was unanimously adopted by the Grocers but the Lumber Manufacturers took no action.

* * * * *

John C. McDonnell, Chief of the Chicago Fire Prevention Bureau, had charge of fire protection matters at the Coliseum during the Republican National Convention. Chief McDonnell recently addressed the Commercial Club of Belleville, Ill., on fire prevention.

* * * * *

President Charles E. Meek and Chairman H. W. Forster of our Committee on Safety to Life addressed the annual convention of the Mill and Elevator Field Men's Association in Chicago during the sessions of the annual meeting of the N. F. P. A.

* * * * *

The Committee on Public Safety of the Cleveland Chamber of Commerce has issued an interesting report on co-operation between communities in case of fire; taking up the matter of the standardization of hose couplings and hydrant fittings in the vicinity of Cleveland. Our member Mr. Charles H. Patton is Chairman of the Committee on Public Safety of the Chamber and would be glad to furnish copies of this report. Mr. Patton has also been recently elected Chairman of the Fire Prevention Committee of the Cleveland Association of Credit Men.

* * * * *

At the last meeting of the Chicago Chapter Mr. Milton A. Strauss of Hart, Schaffner & Marx Company delivered an address on "Fire

Prevention and the Business Man." Mr. Strauss was largely instrumental in securing the establishment of the Bureau of Fire Prevention and Public Safety of which Mr. J. C. McDonnell is Chief. He is one of the most practical and energetic workers for fire prevention in Chicago's merchant class.

* * * * *

One of the interesting social features of the life at the home office and testing station of the Underwriters' Laboratories, Chicago, is the orchestra composed entirely of the Laboratories' staff in which President W. H. Merrill himself plays an instrument. The Laboratories' musicians thus furnish their own music at the staff dinners and other social functions of the big shop.

* * * * *

Herbert E. Choate of Atlanta recently spoke to the student body of the University of Georgia on the nation's preventable fire waste. The southern Atlantic seaboard needs men like our Atlanta member.

* * * * *

H. G. Seibels' indefatigable efforts to redeem Birmingham, Alabama's, unfavorable fire record seem to be getting results.

Julian Kendrick, City Engineer of Birmingham says:

Since May 1, 1915, 5,553 building permits have been issued. They cover the rebuilding of approximately 4,250 flues and the recovering of 2,683 shingle roofs with fireproof material. Sixty-seven notices for unsafe and defective conditions of buildings have been served and complied with.

We have also served notices to trap or enclose the vertical openings in twenty-six buildings within the past month. These buildings are all three stories or more in height and are in the fire district. To see that the building laws are complied with, there have been made 19,567 general inspections. The condition of buildings in the city of Birmingham as regards fire hazards is seventy-five per cent safer than two years ago, owing to the above rigid enforcement of the building laws.

* * * * *

At the annual meeting of the New York Chapter President Miller and Secretary-Treasurer Hardy were re-elected for the current year; the Executive Committee being John Kenlon, Dana Pierce, Howard Chapman, L. I. Neale, D. E. Waid and John C. Eames.

* * * * *

Our member the International Association of Fire Engineers is to discuss as part of its program at its annual meeting in Providence, August 29th to September 1st next, the question "Does the Menace of the Wooden Shingle Justify its Abolition?" Chief Henderson of Bradford, Pa., who represented the Fire Engineers at our annual meeting, referred to the report of the Fire Prevention Committee of that body presented at the Cincinnati convention last year. John Kenlon, Chief of the New York Fire Department, was the chairman of the committee making the report and will undoubtedly be willing to send a copy to our members who may be interested in knowing the attitude of the fire chiefs in the International

Association toward the growing demand for fire prevention work by the uniformed fire fighters.

* * * * *

Members who would like to learn what the State Fire Insurance Commission of Texas is attempting in the way of organized fire prevention service should write the Commission at Austin for a copy of Chief Inspector T. F. Baker's address on the relation between the commission and the city fire marshal, and the duties of that relation. It is a clear, forceful presentation of an excellent plan.

* * * * *

The Department of Public Safety of the city of Asheville, N. C., has issued an interesting little pamphlet for use in the Asheville public schools. The pamphlet gives problems in mathematics in terms of the fire waste. Thus the pupils in the grade schools in practicing their addition, substraction, multiplication and division deal with actual fire loss figures applicable to Asheville. The following are sample problems:

How long could the boys enrolled in the Asheville High School last year be kept at the University with the money lost by fires in Asheville?

If the fire loss could be used in buying bicycles for the children enrolled in the Asheville schools how much would be left for other purposes?

If a man's yearly salary is $2,000 how many years would he have to work to earn money enough to pay the fire loss?

Following these examples, of which there are eighty-one in all, are paragraphs on fire prevention and fire drills. Those interested in this very practical method of bringing the subject of the fire waste before public school pupils should obtain a copy of this leaflet from the Asheville authorities.

* * * * *

Members interested in the matter of small school houses for country districts should avail themselves of the suggestion made at the annual meeting by Chief Inspector L. R. Palmer of the Pennsylvania Department of Labor and Industry and write the State Board of Education at Harrisburg for a copy of the Board's publication *School Architecture* which contains plans for one, two, three and four room school buildings and subsidiary matter on the equipment of small schools. It is a handsome publication of seventy pages.

* * * * *

George W. Cleveland and Captain J. J. Conway of Cincinnati, F. M. Griswold of New York and James E. Latta of Chicago were speakers at the convention of the Ohio Firemen's Association at Lima, Ohio in June.

* * * * *

H. W. Forster, Chairman of Committee on Safety to Life, N. F. P. A. was the speaker on fire prevention at the concluding session of the Western Pennsylvania Safety Rally held under the auspices of the National Safety Council in Pittsburgh, June 19 to 21. Mr. H. M. Wilson, former Chairman of our committee on Mine Fires was Chairman of the local committee which planned the program of the rally.

Meeting of Executive Committee

The usual meeting of the executives following the annual meeting of the Association was held in New York City on June 28th for consideration of matters referred to the Committee by the Association; for revising the roster of the various committees where necessary, and for consideration of reports, finances, communications, etc. The following members were present.:

F. J. T. Stewart, New York, Chairman.
Charles E. Meek, New York, President.
D. Everett Waid, New York, Vice-President.
Louis Wiederhold, Jr., Philadelphia, Vice-President.
Robert D. Kohn, New York, past-president.
H. L. Phillips, Hartford, past-president.
W. F. Ballinger, Philadelphia.
H. W. Forster, Philadelphia.
E. V. French, Boston.
H. O. Lacount, Boston.
R. P. Miller, New York.
C. H. Patton, Cleveland.
C. L. Scofield, Montreal.
Mason R. Strong, New York.
Ira H. Woolson, New York.
Franklin H. Wentworth, Boston, Secretary.

In addition to the usual routine the following items of business were considered and action taken as indicated:

It was voted that the twenty-first annual meeting be held May 8, 9, 10, 1917. A *program committee,* consisting of the President, Secretary and Chairman of the Executive Committee, was appointed, and authorized to select the place of meeting, preference being given to Washington, D. C.

The Budget submitted by the Treasurer was approved.

A *Finance Committee,* consisting of the President, Secretary and Chairman of the Executive Committee, was appointed.

The following appropriations were authorized: New York Chapter, $100; Chicago Chapter, $50; Boston Committee, $50.

Messrs. E. V. French and I. H. Woolson were elected members of the *nominating committee,* 1917, as per Article 7*a*.

A special committee on *Membership,* consisting of the President, Secretary and Chairman of the Executive Committee, was appointed, with the suggestion that the plans of campaign be submitted to the Executive Committee for helpful consideration.

On recommendation of the *Electrical Committee*, the following *resolution* was ADOPTED:

It is the sense of the Executive Committee expressed for the guidance of the committees of the N. F. P. A. that any vote taken in an open meeting of any committee of the Association in which non-members of said Committee participate shall be taken with the understanding that the Committee reserves to itself the right to re-consider the same.

The *resolution* on *occupancy licenses* offered by Mr. Powell Evans at the last annual meeting (Proceedings p. 201) was, after amendment, ADOPTED as follows:

RESOLVED, That it is the sense of this Association that an occupancy license be adopted by all fire prevention authorities in cities and states throughout the country, to be issued after inspection by the proper authorities on every substantial change of tenancy in all buildings within fire limits excepting residences; and

RESOLVED FURTHER, That a copy of this Resolution, with a brief statement of reasons for its adoption and with brief citations of authorities and practice, be sent to all city and state fire control authorities throughout the country.

The matter of brief, descriptive prefaces to technical reports, introduced at the last annual meeting by Mr. Powell Evans (Proceedings p. 240) was considered, and the Secretary was requested to transmit this suggestion to the Chairman of committees, and invite Mr. Evans to submit an illustration of his idea of the form most desirable for such proposed prefaces.

The matter of *Mode of Procedure in Receiving and Adopting Reports*, introduced at the last annual meeting by Mr. Richard L. Humphrey, was considered and the following *resolution* was ADOPTED:

RESOLVED, That except by unanimous consent, no committee report shall be acted upon by the Association in annual meeting which is not received by the Secretary for advance publication before April first of that year.

It was voted to co-operate with the National Safety Council in promoting the observance of *Fire* and *Accident Prevention Day* on October 9th. The following committee was appointed to represent the Association in this effort:

H. P. Weaver, Chicago, Ill.
Sidney J. Williams, Madison, Wis.
Franklin H. Wentworth, Boston, Mass.

The Secretary was authorized to co-operate with the U. S. Bureau of Education in preparing lectures on fire prevention for use in the public schools and other educational institutions of the United States.

Resolution offered at annual meeting by Mr. Herman L. Ekern, adding a paragraph to the platform of the Association (Proceedings p. 298), was APPROVED.

Resolution offered at annual meeting by Mr. W. O. Teague re *conflagration hazards* (Proceedings p. 296) was REFERRED to new committee on High Value Districts.

Remarks of Mr. W. O. Teague at annual meeting on the subject of

misleading advertisements (Proceedings p. 174) were considered, and the Secretary was authorized to address the Associated Advertising Clubs of America, offering assistance to that body, where desired, in discovering the merits of any fire protection devices for which advertisements may be offered.

The following matters presented at the annual meeting were *laid upon the table*:

(*a*) Resolution of E. C. Ferguson (non-member) (Proceedings p. 297).
(*b*) Construction of sidewalk lights (Proceedings p. 299).
(*c*) Resolution of G. G. Wheat (Proceedings p. 300).

Communication from Charles H. Fischer re installation rules for *vapor protection of oil tanks* was REFERRED to Committee on Explosives and Combustibles.

It was VOTED to appoint a committee on *Marine Fire Hazards*.

Communication from H. W. Forster suggesting co-operation with the National Safety Council in the preparation of *fire and accident bulletins for the home*, was favorably discussed, and the following committee was APPOINTED to confer with the National Safety Council in the matter:

F. J. T. Stewart, New York.
H. L. Phillips, Hartford.
Franklin H. Wentworth, Boston.

The matter of a discussion of *City Planning* and fire prevention at the next annual meeting was REFERRED to the Program Committee.

The Secretary was requested to address each year the Chairman of Committees for a report upon the character of co-operation rendered by the members thereof as a guide to the Executives in constituting the committees for the following year.

Action on Committee Reports referred to Executives by the annual meeting.

(*a*) Automobile Fire Apparatus:
APPROVED for publication.

(*b*) Signaling Systems:
Amendments to Regulations APPROVED, (Proceedings p. 122) with the following additional amendment subsequently offered by the Chairman of the Committee:

Rule 8. Section "*c*". Change to read: "Not over fifty (50) boxes or transmitters shall be permitted on a single circuit."

(*c*) Hose Couplings and Hydrant Fittings:
Recommendations for appointment of sub-committees in State fire prevention associations, and appointment of delegate to convention of State Fire Marshals APPROVED.

(*d*) Hydrants and Valves:
APPROVED for publication.

(*e*) Protection of Openings in Walls and Partitions:
(1) Voted to request committee to furnish further information on subject of requirements for *automatic closing* mechanism for fire doors.
(2) Voted to appoint committee on *Vestibule Fire Stops* for openings in fire walls.

(*f*) Automatic Sprinklers:
Regulations for installation of sprinklers in *Railway car houses* were APPROVED.

(*g*) Fire Resistive Construction:
APPROVED for publication.

(*h*) Manufacturing Risks and Special Hazards:
APPROVED for publication.

It was voted to appoint new committees on:
1. Articles of Association.
2. High Value Districts.
3. Small Hose Couplings.

Existing Committees were continued with revisions, and rosters of the same with rosters of new committees will appear in the forthcoming year book.

Real Statistics Promised

Under the above heading there appeared in the QUARTERLY for October, 1914, (Vol. 8, No. 2, p. 135) an editorial comment on the work about to be undertaken by the National Board of Fire Underwriters in the organization of an actuarial bureau for the purpose of compiling statistics of all fire losses occuring throughout the nation. Splendid progress has been made during the past year in this great undertaking which is an object of intense interest to state officials charged with the administration of the insurance losses of the various commonwealths, as well as to all others who are seeking accurate statistics upon the subject of the fire waste.

The New York *Journal of Commerce* has been for some years the source of statistical information on fires, maintaining a special column of telegraphic reports of fires reported as they occur from day to day. It is obvious that reports of losses sent on the day or the day after a fire occurs can be no more than approximately correct. The National Board of Fire Underwriters has gathered statistics from the fire chiefs of all cities of 20,000 population and over, which as far as they go are excellent, and have afforded a basis for reasonably accurate estimates of certain items. Previous to the organization of the present actuarial bureau by the National Board, however, one could not hope for any complete and accurate statistics of the fire waste. It is obvious that any complete record must contain not only the losses suffered by the stock insurance

companies but by the mutual companies as well. Even then, fires in property not insured may escape the tabulations. But the plan is so comprehensive, so liberal and so far in advance of anything we have had heretofore, that we are not disposed to pick flaws in it. For all reasonable purposes it will furnish a complete record as soon as all insurance companies of every character co-operate. Where such co-operation might not be otherwise voluntary it is apt to follow from the demands of the insurance commissioners of the states for special reports. Prior to January, 1915, the insurance companies were required to report their losses to sixteen different states on report blanks which differed in arrangement and in the information called for, but through the establishment of this bureau, with the co-operation of the insurance commissioners and fire marshals, the companies now report paid losses direct to only one state —Texas; and make preliminary reports of losses incurred to only one state — Indiana. The attitude of the state officials themselves toward this undertaking is manifested by the resolutions passed last September by the Convention of Insurance Commissioners. These are as follows:

The Insurance Superintendents and Commissioners, both individually and through their national organization, "The Insurance Commissioners' Convention," have for years past been pressing upon the attention of the fire insurance companies the prevailing dissatisfaction in the public mind regarding fire insurance rates and the importance of some united action on their part to improve rate making methods, to the end that unjust discrimination between classes of risks, different localities and individual insurers themselves might be overcome so that rates, instead of being a matter of estimate, should be ascertained from actual experience. To accomplish that result it was highly essential that the companies should agree upon some uniform system of classification of risks and then combine their experience according to such uniform system in order that the public could know that the rates of fire insurance charged are just and not unreasonable.

Through long continued and persistent effort, having the best interests of the public solely in mind, the Insurance Commissioners by pledging to the companies their unanimous approval and support to an acceptable plan of national classification have induced the companies, members of the National Board of Fire Underwriters, to undertake the work and assume the expense necessary for carrying it out; and a plan for an Actuarial Bureau has been prepared which has received the formal and unanimous approval and promised support of the Insurance Commissioners' Convention, and based upon such promised unanimous support said Bureau has been put into operation by the National Board. The insurance companies adopted January 1, 1915 one uniform system of classification modeled upon the best and latest experience of fire underwriters, and upon the same date the said Actuarial Bureau commenced its work of collecting underwriting experience in the United States from nearly 190 companies, fully one-third of which number were mutuals and other companies not members of the National Board, thus instituting the first bureau for collecting the complete statistics of fire losses and insurance in the United States ever attempted — an experiment so vast and so novel, with promise of such wide advantage to the public, that it deserves the support of all insurance departments; therefore, be it

Resolved, That the Insurance Commissioners' Convention earnestly requests the unqualified support of its every member and of every State Insurance Department in the United States, in making good the promise of this Convention given to the National Board of Fire Underwriters, to the end that the Actuarial Bureau of the National Board of Fire Underwriters may be enabled to obtain a uniform classification of experiences in the fire insurance business.

The number of companies of all classes mentioned in this resolution as co-operating has considerably increased since last September.

During 1915 about 650,000 loss reports were received. The Bureau has received 246,355 reports on losses paid between January 1 and May 1, 1916, and if the present rate continues through this calendar year, the Bureau will have had filed with it over a million reports of losses sustained and paid by its members.

The losses reported as paid during 1915 have been tabulated for each state by cause for each class, divided by construction and protection, but many losses were not reported to the Bureau last year because it was a new undertaking, and for the greater reason that there were not as many companies co-operating then as at present. A tabulation is, however, being prepared which will show the record of losses for the entire country classified by causes and construction.

It was a well recognized fact even in the first year's transactions that the Bureau had undertaken a task of large proportions the details of which, even to an unpracticed eye, were enormous. With an increase in the number of loss reports for the year 1916 to at least one million, and possibly more, to which will be added at the close of the year the writings of the companies, the problem before the Bureau will be a larger one than ever, yet with an office now well organized and its details well arranged, the working out of the plan will be found successful and, we believe, satisfactory.

The experience of the Bureau in its first year has shown a marked difference in judgment as to the classifying of hazards, and the process of education toward uniformity in the direction of classification, going on quietly and efficiently, has been of great value to the companies in uniformly assigning risks to the various classes.

Many cases have developed from loss reports made to the Bureau where companies have been taken advantage of, either through ignorance or dishonesty of the assured or the agent, or both, in the matter of adjustment. In addition, it has frequently been reported to the Bureau that losses have occurred and been paid, which on further examination have indicated attempts to defraud, as no loss had occurred.

Below are given a few of the many hundred irregularities which have been discovered in the course of the year in connection with loss reports, some of which were undoubted attempts at fraud, others the result of ignorance and a few of carelessness.

Examples of False or Excessive Claims for Loss — Reported by the Actuarial Bureau.

On February 3, 1915, we received cards from two companies reporting loss paid on a fire of December 21, 1914, name of assured, date of fire and location being the same. Company A reported a claim for loss on household furniture on the second floor, being the only company interested, and paid loss of $38.25 on a policy for $1,000. Company B reported a loss claim on household furniture on the second floor, that it was the only company interested, and paid loss of $40 on a policy for $500. The insurance and the loss claims were upon one and the same risk.

Both companies were communicated with and it developed that neither company knew of the insurance carried by the other.

On October 14, 1915, we received a report of a loss from one company, and on the 16th from another, giving same name of assured, date of fire and location, and reporting loss on household furniture in a brick mercantile building on August 8, 1915. Company A stated that it carried $800, being all the insurance on this furniture, and paid loss of $175, which was the total value of the property damaged or destroyed. Company B stated that $700 was carried on household furniture, $75 loss was paid, and only one company was interested. Investigation proved that each company had made a separate adjustment, that the adjustment was not satisfactory to either company and that both had cancelled their policies. Neither company knew of the other insurance, but upon receipt of our advices the question was taken up and the adjustment re-opened. The first company mentioned received a salvage or return payment of $81.67, the other company $40, making the net loss $128.33 instead of $250 as per the first settlement. Cases of this kind have been of frequent occurrence.

On October 7, 1915, we received a report card from a company reporting loss to contents of a farm barn, cause of fire given as explosion on August 2, 1915, amount of damage, $800. Local investigators were unable to discover any fire on or before the date of receipt of card for any such assured.

On May 21, 1915, we received a card reporting loss of April 24, 1915, which damaged household furniture in a frame building. Investigation developed the fact that this was vacant ground on the date the fire was reported to have occurred.

On September 25, 1915, we received a report from a company stating that it had paid a loss on a frame dwelling for fire of July 10, 1915. Upon investigation the tenants stated that there had never been a fire in the building.

On October 1, 1915, we received advices from a company that it had paid a loss amounting to $235 on a frame dwelling. Investigation showed no evidence of this building ever having been damaged by lightning or fire.

On October 25, 1915, we received a card from a company reporting a fire of October 10, 1915, on which it had paid a total loss. Investigation failed to show that any fire had occurred on this date in the premises, or for the assured named in the report.

On October 22, 1915, we received a card from a company reporting that it had paid $118.80 loss on a fire of May 8, 1915. Investigators were unable to find any man of the name given who had a fire anywhere in that vicinity.

The growth of the claimant files has been very rapid, and these now contain much valuable information. In addition to the fires of incendiary origin, we have record of a large number of cases where one assured has had fires so frequently as to indicate other than accidental origin. A few examples are given:

Fires were reported as occurring on December 16, 1914, January 5, 1915, January 31, 1915, and February 24, 1915, all in the same building and each having a loss of over one thousand dollars ($1,000). Three companies were interested in the first two fires, three other companies in the second two fires.

Fires are reported as having occurred in the same building for the same assured on May 5, 1914, October 20, 1914, November 27, 1914, December 19, 1914, January 19, 1915, and November 7, 1915. The loss entailed by the first four of these fires was paid by the same three companies, the loss on the last two fires was paid by three other companies, indicating that the first three companies refused longer to carry the risk, after which it was insured in other companies.

Comparative Statistics of Fire Loss.

The Committee on Statistics and Origin of Fires of the National Board of Fire Underwriters has recently submitted its annual report on the fire losses for the year 1915. A summary of this report is presented herewith in the thought that our members will find the data of special interest and also of assistance in advocating improvements in their local city or town.

Referring to the statistics for the year 1915 the committee says:

It is becoming more generally realized that America's extraordinary fire losses, as compared with those of other countries, constitute a serious drain upon our national resources. Exact data as to the extent of this wastage is, therefore, of importance in all estimates of the country's prosperity. The development of fire fighting and fire prevention methods can best be appraised in the light of their results, and these broad statistical summaries give the truest indication of success or failure. The chiefs of the various fire departments, who by their prompt and careful returns, make possible for us to assemble this information, are rendering an important public service.

If the basis used by the United States Census Bureau in estimating the population of communities is correct, there are in this country three hundred and forty-one cities whose population is twenty thousand and upwards in comparison with about two hundred and fifty ten years ago; an increase worthy of note from a statistical viewpoint. We have secured reports from three hundred and thirty-six cities, the largest in point of number since this work was inaugurated, and in a great majority all the inquiries on our blank form have been answered; this no doubt being due to the adoption by upward of two hundred and seventy-five cities of our Fire Record Book. It is evident that the representatives of our members are co-operating in better manner than formerly with the fire chief by furnishing him the amount of loss, but there yet remain a few exceptions and for no apparent reason. The amount of a loss by fire is no longer, and in fact never should have been considered, a "state secret" and every agent ought to be willing to co-operate with the fire department in this small matter.

A study of the record of 1915 in comparison with its recent predecessors encourages the hope that in some places the fire prevention efforts have produced good results and the progressive cities in such matters are to be commended. The chief of fire department who has established a fire prevention bureau as an adjunct of the fire department and details experienced firemen to inspect premises for hazardous conditions, is responsible for much of the lessened fire loss in many cities. Men trained as fire-fighters are not only competent but they have learned in their work to recognize the possibilities of hazardous conditions, and given authority to order the removal of all evident fire hazards and demand the exercise of greater care in and about premises, will do much to prevent fires and lessen the loss of life and property. The city official — Mayor or chief of fire department — that has not organized a fire prevention bureau, examining the statistical data presented with this report, will be impressed with the accomplishments in neighboring places. It not only makes the fire department an agent for the prevention of fires but through the knowledge obtained by the inspection of buildings, the firemen have an acquaintance with the construction and equipment of premises which will stand them in good stead in the event of a fire.

The losses in European cities continue to be much less per capita than for the United States and Canada. However, it was most encouraging to see the figure for the United States per capita loss drop to $1.71 as compared with an average of over $2.00 for the last few years. Members residing in those cities showing a per capita loss in excess of $5.00 should

make every effort to enlist the various public spirited organizations of the city in a campaign of improvement. There is always a remedy for the causes producing such a result and a sufficient effort will find that remedy.

CITIES IN WHICH LOSS EXCEEDED $5.00 PER CAPITA.

1915

Newport News, Va.	$28.00	Danville, Ill.	$6.86
Clinton, Ia.	12.46	Joliet, Ill.	6.83
Augusta, Ga.	11.87	*Galveston, Tex.	6.52
Raleigh, N. C.	10.37	Springfield, Ill.	6.47
Key West, Fla.	9.41	‡Fresno, Cal.	6.24
Lockport, N. Y.	9.31	‡Port Huron, Mich.	6.06
Muncie, Ind.	9.16	†Salem, Mass.	5.85
Davenport, Ia.	8.80	Muskegon, Mich.	5.57
*Trenton, N. J.	8.11	Williamsport, Pa.	5.48
Erie, Pa.	7.78	†Dubuque, Ia.	5.35
‡Shreveport, La.	7.64	Burlington, Ia.	5.14
Wilkinsburg, Pa.	7.50	Oswego, N. Y.	5.14
*Montgomery, Ala.	6.94		

1914

*Galveston, Tex.	$33.06	Portland, Ore.	$6.78
Pottsville, Pa.	20.38	Kearny, N. J.	6.48
‡Port Huron, Mich.	16.13	Kenosha, Wis.	6.47
*Trenton, N. J.	15.32	Portland, Me.	6.26
Decatur, Ill.	15.28	*Binghamton, N. Y.	6.24
Manchester, N. H.	14.07	Waco, Tex.	6.12
*Superior, Wis.	13.86	*East St. Louis, Ill.	6.10
Charleston, W. Va.	13.83	‡Shreveport, La.	6.05
*Waterloo, Ia.	12.60	Pasadena, Cal.	5.97
†Gloversville, N. Y.	12.29	*Pittsfield, Mass.	5.93
‡Fresno, Cal.	12.03	Portsmouth, Ohio	5.93
*Montgomery, Ala.	10.51	Memphis, Tenn.	5.67
*Sioux City, Ia.	10.43	Albany, N. Y.	5.46
Vicksburg, Miss.	9.38	Montclair, N. J.	5.12
*Leavenworth, Kan.	9.12	Fort Worth, Tex.	5.05
†Birmingham, Ala.	7.37	Mobile, Ala.	5.04
Charlotte, N. C.	7.28		

1913

*Columbus, Ga.	$40.91	Elmira, N. Y.	$8.49
†Ottumwa, Ia.	16.39	Jackson, Miss.	7.58
Cohoes, N. Y.	15.43	Parkersburg, W. Va.	7.50
Savannah, Ga.	13.91	*Norwood, Ohio	7.30
‡Port Huron, Mich.	13.72	*Walla Walla, Wash.	6.99
Quincy, Ill	13.26	*Columbia, S. C.	6.50
†Salem, Mass.	12.08	*Binghamton, N. Y.	6.45
†Gloversville, N. Y.	11.81	Springfield, Mo.	6.42
Dayton, Ohio	11.60	*Little Rock, Ark.	6.31
†Dubuque, Ia.	10.43	Peoria, Ill.	5.83
*East St. Louis, Ill.	10.12	Boston, Mass.	5.79
Lynchburg, Va.	9.94	‡Fresno, Cal.	5.52
Everett, Wash.	9.69	Burlington, Vt.	5.39
*San Jose, Cal.	9.39	Stockton, Cal.	5.33
‡Shreveport, La.	9.17	*Flint, Mich.	5.01
New Rochelle, N. Y.	8.69		

1912

*Houston, Texas	$51.14	*Waterloo, Iowa	$6.71
North Adams, Mass.	15.41	Fort Smith, Ark.	6.63
*Sioux City, Ia.	12.69	*Dallas, Texas.	6.32
*Petersburg, Va.	11.71	‡Shreveport, La.	6.05
Moline, Ill.	11.60	Belleville, Ill.	5.87
†Ottumwa, Iowa	10.65	Easton, Pa.	5.66
*Flint, Mich.	10.38	*South Bethlehem, Pa.	5.66
Butte, Mont.	9.84	†Birmingham, Ala.	5.57
*Columbia, S. C.	9.69	*Meridian, Miss.	5.54
*Pittsfield, Mass.	9.13	*Norwood, Ohio	5.32
*Columbus, Ga.	8.67	Rockford, Ill.	5.20
‡Fresno, Cal.	7.75	Taunton, Mass.	5.06
Perth Amboy, N. J.	7.15	*Tacoma, Wash.	5.04
*Walla Walla, Wash.	6.74	Newport, R. I.	5.01
		Haverhill, Mass.	5.01

1911

Bangor, Me.	$137.43	Minneapolis, Minn.	$6.74
*Houston, Tex.	44.50	Muskogee, Okla.	6.67
Winona, Minn.	21.08	†Ottumwa, Ia.	6.55
*Little Rock, Ark.	17.24	Amsterdam, N. Y.	6.49
†Dubuque, Ia.	15.01	*Superior, Wis.	6.47
Sheboygan, Wis.	11.30	Wichita, Kan.	6.47
Paducah, Ky.	11.15	Battle Creek, Mich.	6.35
‡Port Huron, Mich.	10.73	*South Bethlehem, Pa.	6.25
Ogden, Utah	10.36	Racine, Wis.	6.06
So. Omaha, Neb.	10.13	†Gloversville, N. Y.	6.05
Council Bluffs, Ia.	8.88	*San Jose, Cal.	6.01
Gloucester, Mass.	8.46	†Salem, Mass.	5.63
*Leavenworth, Kan.	8.14	Duluth, Minn.	5.52
Troy, N. Y.	8.07	Reading, Pa.	5.48
Malden, Mass.	7.53	†Birmingham, Ala.	5.24
Kalamazoo, Mich.	7.52	Brookline, Mass.	5.14
*Dallas, Tex.	7.07	Atchison, Kan.	5.09

*These cities in this class in two of the five years.
†In this class three of the five years.
‡In this class four of the five years.

*Annual Fire Losses in the United States for Forty-one Years — 1875-1915 Inclusive.

YEAR	AGGREGATE PROPERTY LOSS	YEAR	AGGREGATE PROPERTY LOSS	YEAR	AGGREGATE PROPERTY LOSS
1875	$78,102,285	1889	123,046,833	1903	145,302,155
1876	64,630,600	1890	108,993,792	1904	229,198,050
1877	68,265,800	1891	143,764,967	1905	165,221,650
1878	64,315,900	1892	151,516,098	1906	518,611,800
1879	77,703,700	1893	167,544,370	1907	215,084,709
1880	74,643,400	1894	140,006,484	1908	217,885,850
1881	81,280,900	1895	142,110,233	1909	188,705,150
1882	84,505,024	1896	118,737,420	1910	214,003,300
1883	100,149,228	1897	116,354,575	1911	217,004,575
1884	110,008,611	1898	130,593,905	1912	206,438,900
1885	102,818,796	1899	153,597,830	1913	203,763,550
1886	104,924,750	1900	160,929,805	1914	221,439,350
1887	120,283,055	1901	165,817,810	1915	172,033,200
1888	110,885,665	1902	161,078,040		

*These figures are obtained from the Records of the Journal of Commerce, deducting the Canadian losses.

Comparative Fire Losses.

	Number of Cities Reporting Loss					Population					Per Capita Loss				
	1911	1912	1913	1914	1915	1911	1912	1913	1914	1915	1911	1912	1913	1914	1915
United States	298	300	298	298	333	31,210,084	32,326,633	33,281,804	40,213,230	35,161,266	2.62	2.55	2.25	2.32	1.94
Argentina		1	1				1,428,042	1,428,042				3.58	4.21		
Austria	1	4	4	1		2,031,498	2,658,078	2,734,936	157,000		.08	.30	.25	.42	
Belgium		1	1				166,445	168,812				.69	1.36		
Canada	1	5	6	6	3	125,000	957,372	612,453	597,709	249,344	2.61	2.88	2.46	3.58	2.79
Chile			1		1			200,000		220,000			.30		.58
England	12	12	14	9	8	9,898,317	7,164,849	7,396,664	6,916,651	6,442,239	.53	.54	.33	.67	1.03
France	3	6	5	3	3	3,518,493	4,425,696	3,945,743	3,659,224	3,957,729	.81	.84	.49	.63	1.02
Germany	8	9	8	4	2	2,306,354	2,659,575	2,559,608	836,007	423,673	.21	.20	.28	.17	.49
Hawaii			1					45,000					.69		
Ireland	2	2	2	2	2	694,272	699,808	701,400	700,000	701,500	.58	.57	.28	.39	.55
Italy	6	3	5	5	3	1,373,995	282,082	1,161,465	1,189,458	1,078,691	.31	.90	.25	.37	.62
Japan			3	10				2,481,528	5,611,983				.59	.44	
Norway		1	1	1			250,000	250,400	251,000	253,000		.69	.32	.48	.72
Philippine Islands			1	1	1			234,409	234,409	234,409			4.41	1.28	1.00
Russia	2	2	2	1	1	3,483,291	3,485,583	3,710,000	1,617,157	2,000,000	1.17	.84	.89	1.19	.95
Scotland	2	2	3	1	3	484,190	485,091	1,516,905	163,891	1,534,591	.56	.49	.36	5.35	1.62
South Africa				1					50,000					1.77	
Spain			1	1	1			605,870	606,150	608,700			2.30	.15	3.13
Sweden		1	1	1			351,500	383,000	386,211	392,427		.13	.74	.54	.29
Switzerland		1	1	1			140,000	142,000	145,000			.04	.15	.19	
The Netherlands		2	1	1	1		417,693	301,846	312,424	321,853		.12	.11	.07	.14

	Population	Total Loss	Per Capita
1911 — Whole country	93,927,000	*217,004,575	2.31
298 cities	31,210,084	† 81,790,877	2.62
1912 — Whole country	95,410,503	*206,438,900	2.16
300 cities	32,326,633	† 82,297,386	2.55
1913 — Whole country	97,163,330	*203,763,550	2.10
298 cities	33,281,804	† 74,876,608	2.25
1914 — Whole country	98,781,324	*221,439,350	2.24
298 cities	40,213,230	† 93,368,795	2.32
1915 — Whole country	100,399,318	*172,033,200	1.71
333 cities	35,161,266	† 68,386,218	1.94

*Estimated. †Actual figures reported.

ELECTRICITY IN HAIR IGNITES CELLULOID

The Insurance Field.

Tangible evidence of the perilous combustibility of celluloid is afforded by a recent occurrence in New York City. Doris, the four-year-old daughter of a member of a printing firm, was combing her hair at a considerable distance from any open flame of any sort when she happened to notice that the comb was sputtering and had presence of mind to throw it upon the floor. The little girl's grandfather was in another room and his attention was attracted in time to throw the comb into the kitchen sink and extinguish it. Photographs of the little girl and of what was left of the comb are reproduced herewith.

That a spark of static electricity from the hair was the only cause for the ignition of the comb is apparently indisputably manifest by the father's examination into the occurrence. The little girl was standing in the kitchen at the time but was some eight or ten feet away from the gas stove where only one burner was lighted and that was turned very low in order that some simmering broth might not boil over. The little girl strenuously denies that she was anywhere near the stove or that she had a match in her possession and these facts are borne out by the testimony of the grandfather who was in the next room, with the door open between, and who had been watching his grandchild and had only momentarily looked away when his attention was again attracted by the sound when she threw the comb upon the floor.

The little girl's story is simply that she was combing her hair when she noticed that the comb was burning and dropped it in haste.

This seems to be the only case on record in which the exceeding inflammability of celluloid is shown in this manner. The comb was just a cheap pink affair bought for the little girl simply because it was pink and that was her favorite color.

THE COMB AND THE GIRL

The little girl's father is seeking no publicity in connection with the occurrence but is willing that his name be given by *The Insurance Field* to any who may inquire.

Railroad Snowsheds and the Fire Problem.

By Niles Searls (Member N. F. P. A.)
General Fire Inspector Southern Pacific Railway Company.

A Brief Description of the Snowsheds in the Sierra Nevada Mountains of California on the Line of the Southern Pacific Railroad, and the Methods Adopted to Detect, Report and Extinguish Fires.

The snowshed is not peculiar to the Southern Pacific Company, but on no other road in existence are sheds so extensive and continuous as on the line of this Company where it crosses the high Sierras.

The following extract from an article in the United States Weather Bureau's "Monthly Weather Review" for May, 1915, will make the reason for this quite apparent:

"California, usually thought of as a land of fruit, sunshine and flowers, also has within its borders *the region of greatest snowfall in the United States.* * * * Though there may be a greater average seasonal snowfall in some of the uninhabited and unstudied portions of the United States, the records obtained in the high Sierras of California have not been exceeded. *Particularly is this true of the region adjacent to the line of the Southern Pacific Railroad* which connects Sacramento, California, with Reno, Nevada."

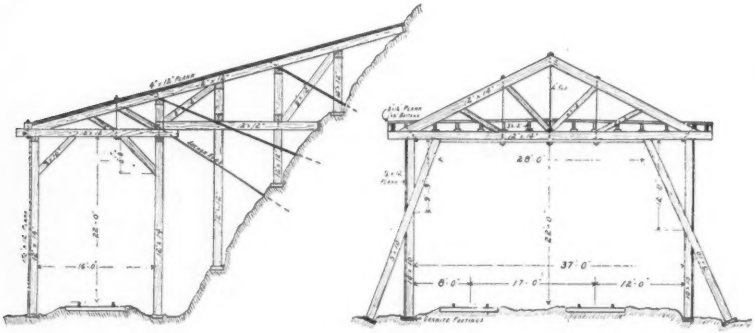
From tables of snowfall contained in this article, it appears that the average seasonal snowfall at Summit station on the Southern Pacific is 35 feet, with a maximum recorded fall during one season of 65¼ feet. The actual depth of snow on the ground will vary from 12 to 30 feet on the level up to hundreds of feet in the drifts. What this depth of snow means can be inferred from the fact that, during a large portion of the winter season, the regular equipment of the telegraph linemen, working out of Summit, consists of snowshoes and shovels, instead of climbing irons. The accompanying photograph, taken on the first of March of this year, shows the snow field just east of Summit. At the time this picture was taken there were several places in the vicinity where the snow was 70 feet in depth on top of the shed.

In going down from Summit, both east and west, the snowfall decreases with the altitude, but the heavy fall extends much further down on the western slope than on the eastern. Below the points where an average seasonal fall of 200 inches is encountered, it is found practical to keep the line open by means of snow plows, but above these points sheds are necessary. These points are reached at Blue Canon, on the western slope, at an elevation of 4,700 feet, and a short distance west of Truckee,

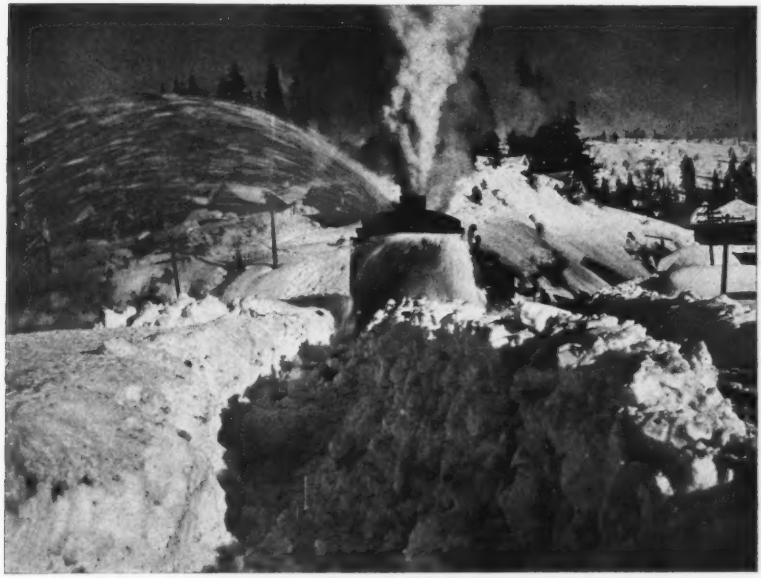
Snow Field East of Summit, March 1, 1916.
Top of shed just visible in lower left of photograph.

on the eastern slope, at an elevation of 6,000 feet. Between these two points, a distance of 40 miles, is the shed district.

In this district is constructed 29 miles of snowshed, of which about 28 miles is continuous, with the exception of such natural breaks as are caused by tunnels and viaducts. Below the continuous shed the track is protected, at such points as experience has shown to be necessary, by detached sections of shed, varying in length from 130 to 1,500 feet. The present distribution of shed is 77 per cent west and 23 per cent east of Summit.

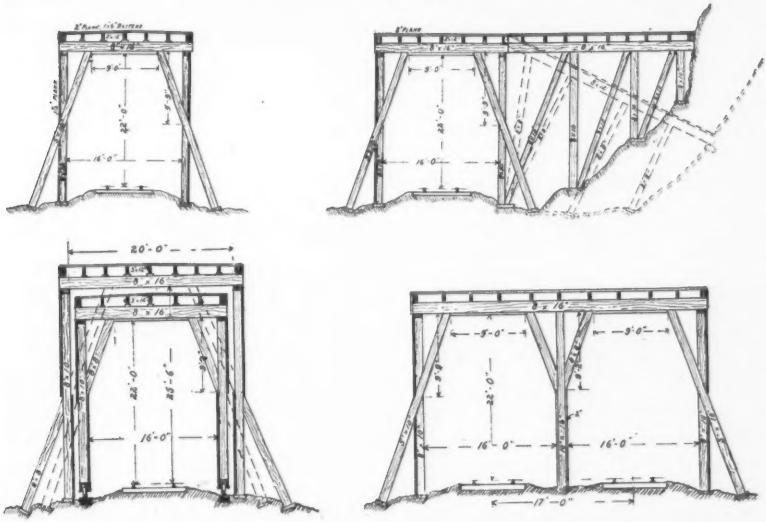


Types of Snow Shed

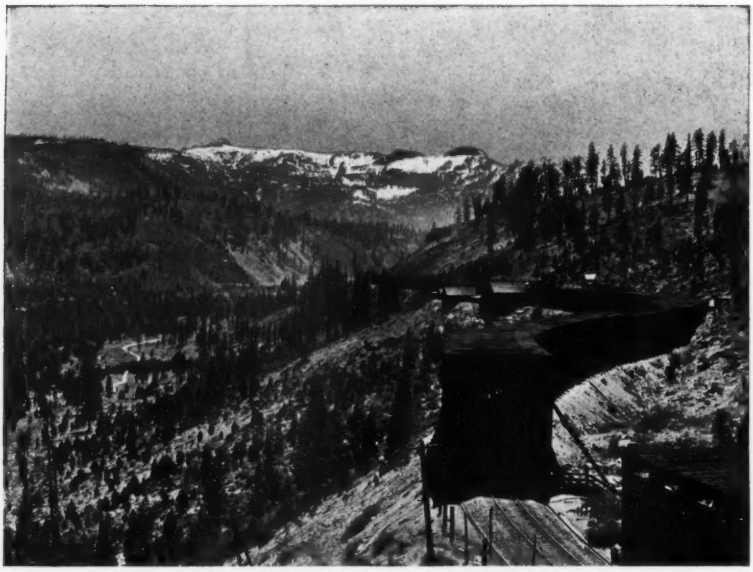


Snow Plow in Operation Blue Canyor, Cal.

The varying conditions call for varying forms of shed, some with sloping roofs pitched away from the hills, others level or peaked. The



TELESCOPE SHED



Snow Sheds near Lakeview, Cal. Telescope section in foreground.

latest type gives a clearance of 22 feet above the track. The photograph shows a summer view of the shed not far from the point where the winter snow view was taken. In the immediate foreground of this picture is shown an open telescope section. These telescope sections are introduced wherever possible to act as fire stops and consist of a section of shed, about 100 feet in length, mounted on rollers or wheels which run on tracks parallel with the axis of the shed. In summer these sections are run back into the enlarged portion of the adjoining shed, leaving an open space of 100 feet.

Perhaps a better idea of the extent of these sheds will be conveyed to some readers by the fact that, as now constructed, they contain 97 million feet board measure of rough pine lumber, and that the estimated cost of renewal is $2,326,600.

In strong contrast with the extreme winter condition, is the summer in this district, when for a period of from five to six months, an almost unbroken dry season prevails. Under these conditions, the fire hazard of such extensive frame structures, exposed both from within and without, is very evident, and it was only a short time after the commencement of the shed construction that this fact was brought home to the Company by the destruction of over a mile of shed by fire, and for a period of thirty-one years following, the average loss per year was 1,770 feet. During the last fourteen years this annual loss has been reduced to 563 feet, this reduction being largely due to the use of oil instead of coal or wood as

Fire Train in operation, Blue Canyon, Cal.

fuel, thus practically eliminating the spark hazard, and partly due to improved methods of detecting and extinguishing fires when they do occur.

Fire trains were installed immediately following the first fire, which occurred in 1870, and have been continued in service ever since, and are the principal means of extinguishing fires in this district. The equipment of the early fire trains was rather meager and at one time one of them was caught in a shed fire, and, being unable to fight its way clear, was destroyed, together with a large section of shed. The present fire train service consists of four trains located — one at each end of the shed district and two at points of vantage in the shed. Each train is made up of a standard ten-wheel locomotive and two water cars. Each engine carries a duplex fire pump having a capacity of 300 gallons per minute, and an inspirator capable of handling about 100 gallons per minute. The total water capacity of the train is about 20,000 gallons. Each train carries 1,000 feet of 2½-inch cotton rubber-lined hose, fitted with National Standard couplings (as is all of the fire hose of this Company), and, in addition, carries full equipment of ladders, axes, pike poles, buckets, and other like apparatus. Steam is carried, at all times, on the engine and a crew is on duty day and night. The photograph shows the Blue Canon fire train in action, testing out the pump and inspirator.

During the last fourteen years there have been five large loss fires, but in no case has there been any failure of the equipment to stop a fire at the point at which it was encountered on the arrival of the train. During

Observatory Building, Red Mountain.

the same period of fourteen years over 200 incipient or exposure fires have been successfully handled, any one of which might have caused serious loss if not promptly extinguished.

For communicating fire alarms to the fire trains, the telegraph was first employed, followed in a short time by two independent alarm systems — one being a "Gamewell" system with gongs at the fire train stations and boxes distributed through the sheds, used for fire alarms only, and the other a district alarm system with central office in a reinforced concrete, fireproof building at Summit, this latter system also being used as a watchmen's detector system, all watchmen and patrolmen being required to report, over this system, at regular intervals to the central office.

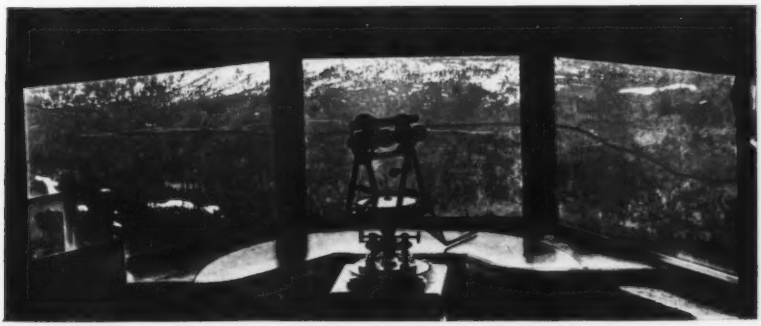
It soon developed that, with watchmen located only in or on the shed, exposing forest fires could and did obtain considerable headway before discovery, and the desirability of a station from which a comprehensive view of the sheds and the adjacent country could be obtained was apparent. Such a point of vantage was found on the summit of Red Mountain, or Signal Peak as the Government calls it. This mountain, whose summit is at an elevation of 7,860 feet above the level of the sea, stands on the north side of the main canon, on the south side of which the road winds its way through the mountains. This summit is at an average elevation of 1,800 feet above the track, in the shed district, and distant therefrom

"Red Mountain" from the track, near Cisco. Cross indicates observatory.

one and one-half to twelve miles in an air line. A portion of the view, as obtained from this summit, is shown in the small panoramic picture. The advent of the telephone in 1876 made it possible to utilize this location for observation purposes, and a telephone line was constructed and watchmen located on this mountain in that year, being one of the first practical uses of the telephone on the Pacific Coast.

Seven years ago the present stone observatory building, shown in the photograph, was erected, and the method now employed in locating fires was put in service. This method, being somewhat novel and peculiar to this station, will be described in detail:

There are two points in the near portions of shed which are cut off from view by the extreme tops of intervening mountain peaks, and the observation bay of the building is so constructed and located that the supporting mullions are brought opposite these natural blind spots. Incidentally, the shed at these two spots is under the special observation of a watchman located on top of tunnel 4, who has an unobstructed short range view of both points.



Interior of Observatory showing transit, map and faintly, the etched line on window and portion of sheds in distance.

A portion of the ————

In the clear air of this altitude, a good pair of eyes and constant watchfulness are all that is necessary during the normal daylight conditions, but at night, or at any time when the clear view of the shed is impossible, it becomes necessary to provide some means by which the many fires appearing can be accurately located in reference to the shed. To accomplish this, the apparatus, as shown in the picture of the interior of the bay, is installed. This consists of a transit, mounted on a fixed pier, in the center of the bay, and a map etched on a silver-plated copper plate located on a shelf in front of the transit. The shed line on this map is inlaid with black enamel, and along this line is indicated in different colored enamels each station, tunnel, mile post, signal box, etc., in its proper location. Over this map swings a knife-blade pointer attached to, and coinciding with the axis of the transit.

On the plate glass of the window, and opposite the cross-hairs of the finder, is etched an opaque line exactly coinciding with the shed. This line shows rather faintly in the photograph of the interior. This line is so located that when the cross-hairs of the transit cut the shed, the cross-hairs of the finder cut a corresponding portion of the etched line. This line is located opposite the finder, which is a simple peep tube provided with cross-hairs, for the reason that it would be impossible to focus the glass of the transit on this line at such short range, and also to prevent the blurring of the shed view through the transit which would be caused by the presence of an opaque line so close to the object glass.

The operator, at night, sits in this bay in semi-darkness and keeps a general lookout over the surrounding country. On observing a fire, or a suspicious light, he turns the transit on to it and then presses a button which controls a small, battery-operated electric light, illuminating the map and the etched line, the reflection of this light from the plate glass of the window also serving to illuminate the cross-hairs of both transit and finder. Under these conditions of illumination, a glance through the finder at the etched line determines whether the fire is above, below or in the shed, and the position of the pointer indicates its exact location

view from Red Mountain

along the shed. If the fire is a small campfire, too close to the shed, word is sent to the nearest section headquarters and men sent to move the parties to a safe distance and extinguish the offending fire. In case of an actual fire in shed, or of an exposure fire of magnitude, the fire trains are called, the ones nearest the fire going directly to the reported scene, and the others closing in as in regular fire department service.

As a sample of the accuracy with which even small fires can be located from this station, I will cite an instance that occurred on October 2nd of last year. On the evening of that date, a section foreman took it into his head to sharpen some track chisels, and, for that purpose, took a portable forge and set it up outside of the shed, but in direct line between the shed and the observatory, and proceeded to kindle a fire in the forge. This fire was observed by the watchman and, being apparently in the shed, the fire train was called, ran two miles and stopped exactly opposite the location of the forge before the chisels had been brought to a working heat.

At another time the agent at Midas, a station well below the shed district and at a distance of about 18 miles from the observatory, received a message from the watchman stating that a small fire was burning "about 10 feet back of the freight house" at his station. Investigation disclosed a tramp's campfire at the point indicated. Other instances could be given, but these serve to show what the installation is capable of accomplishing.

This article is intended to be simply descriptive of existing conditions and methods, and is no place for the discussion of what might be done by other means to prevent or reduce the fire loss, but I will state that serious consideration has been given to many proposed schemes from more or less visionary ones, involving the fireproofing of the existing frame structure up to and including the installation of automatic sprinklers, but, under the existing conditions, all these have been determined to be impracticable.

The substitution of reinforced concrete shed for some, or all of the existing frame structure, will probably furnish the final solution of this

particular fire problem, although there are many arguments against this form of construction, in addition to the great expense involved, which, although not apparent to the layman, it is unnecessary to mention at this time.

WHO AM I?

I am more powerful than the combined armies of the world.

I have destroyed more men than all the wars of the world.

I am more deadly than bullets, and I have wrecked more homes than the mightiest of siege guns.

I steal in the United States alone over $300,000,000 each year.

I spare no one, and find my victims among the rich and poor alike; the young and the old; the strong and the weak; widows and orphans know me.

I loom up to such proportions that I cast my shadow over every field of labor from the turning of the grindstone to the moving of every train.

I massacre thousands upon thousands of wage earners in a year.

I lurk in unseen places, and do most of my work silently. You are warned against me, but you heed not.

I am relentless. I am everywhere; in the home, on the street, in the factory, at railroad crossings, and on the sea.

I bring sickness, degradation and death, and yet few seek to avoid me.

I destroy, crush or maim; I give nothing but take all.

I am your worst enemy.

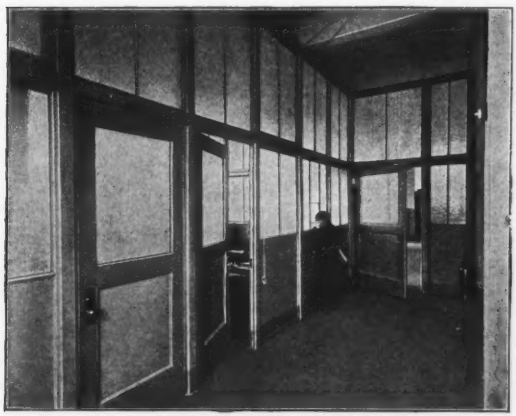
I AM CARELESSNESS.

Fire Retardant Partitions.

While it is generally admitted that modern science can make a building fire-proof, the fact remains that the contents' hazard is often severe.

Next to the prevention of fires — which seems to be an immediate impossibiiity — the most promising avenue toward the minimizing of fire loss seems to lie in the segregation of a fire within a limited space.

The illustrations herewith are from some photographs taken in the office building of Thomas A. Edison, Inc., at West Orange, N. J. In the erection of his new plant, following the great fire of over a year ago, Mr. Edison equipped his new office building with metal partitions. It is interesting to observe that Mr. Edison while somewhat unresponsive to certain ideas of fire protection realizes after his recent experience that the contents of a building may burn a building. Where a considerable extent of floor space is to be divided into small areas by partitions there is no doubt of the value of the metal partition, which does not add to the burnable material while offering a fire retardant barrier to fires which may start in the small areas. The automatic sprinkler has not yet wholly invaded the modern office building although there are a good many having sprinkler protection, and so for this class of buildings, the makers of metal building materials and furnishings are devising interior partitions as a sort of supplement to the metal window frame idea — developing the fire barrier scheme as against that of fire extinguishment. There is, however, ample opportunity for both barriers and extinguishers.



A very considerable future use may be made of the metal partition. Tenants in most office buildings frequently shift about and the owners of such properties are continually called

upon to make new divisions of floor space to suit new occupants. Standard metal panel units may be conveniently shifted about to fit new situations with the minimum of litter and defacement of walls.

Such partitions may be manufactured, not built; which means that parts may be made in quantities true to gauge and pattern by means of special machines and dies which assure uniformity. These parts may then be assembled into completed units of dimensional exactness.

The upper panels may be of steel or glass, as desired — the latter, of course, being preferred where interior division without impairment of lighting is sought. Obviously, for fire retardant purposes, wired glass may be used — either polished or in some of the figured patterns.

The Dry Powder Fire Extinguisher.

Our members and friends in Great Britain have naturally been put under severe stress during the war not only by the speeding up of factories in the manufacturing of explosives, which agencies have caused many fires in America also, but because of the air raids by the enemy and the dropping of bombs into the coast towns, which have set numerous fires as well as occasioned loss of life. It is natural under such cricumstances that the devices offered for fire extinguishment should come under critical examination.

The zealous purveyors of the dry powder fire extinguisher, the delusive red tube which is still purchased by uninformed Americans, have been very much in evidence in the promotion of wares of this sort in Great Britain and the investigation made of this class of devices is of a character typical of the serious Briton. Instead of dismissing it with the amused contempt peculiar to Americans, (which is not the best method of discouraging its purchase for the reason that a negative action is not so good as a positive one), the English fire preventionists secured the appointment by the Secretary of State for the Home Department of a special committee to conduct experiments to test the value of dry powder fire extinguishers

as compared with water and "first aid" appliances for extinguishing or effectively controlling fires such as might be caused by bombs dropped from airships. This report has been presented to both Houses of Parliament by command of the King and is published and for sale for one penny by the publisher, T. Fisher Unwin, Limited, London, W. C., of whom copies may be obtained. The committee held a preliminary meeting and drew up a scheme of tests which were carried out in April. Representatives of the Home Office, Admiralty Air Department, Ministry of Munitions, Office of Works, National Physical Laboratory, Government War Risks Insurance Committee and the London County Council were present. The tests were carried out at the London fire brigade headquarters and in some condemned house property adjacent thereto. An elaborate log of each test is published in the leaflet referred to. The conclusions of the committee making the tests are as follows:

In the opinion of the Committee the conclusion to be derived from the experiments is that, while none of the agents employed could be said to have any material effect on the combustion of the bomb itself, there was a very marked general difference between those experiments in which water was used and those in which dry powder was applied. The spread of the fire caused by the bomb was greatly limited and in some cases totally prevented by the application of water; whereas after the application of the dry powder the fire continued to burn, although at each application some temporary check to the fire was noted.

Recent analyses made for the Committee show that dry powder fire extinguishers generally contain as their main constituent bicarbonate of soda, the amount of which varies from about 46 per cent to nearly 56 per cent in the different samples examined. It is true that bicarbonate of soda on heating gives off a certain quantity of carbon dioxide gas, but in the opinion of the Committee it is doubtful if the quantity generated has a materially effective influence on the action of the powder as an extinguisher, except possibly in cases of small fires of a special nature and limited extent. The Committee would also draw attention to the remarks in the appendix as to the comparative quantity of steam produced from an equal weight of water.

Water, although failing to extinguish the bomb itself in its earlier stages of combustion, is far more effective than dry powder, the wetting of the surrounding material preventing the spread of the fire and thus confining its area to the immediate neighbourhood of the bomb. Water proved itself also much the more effective extinguishing agent for the fires caused by the bombs.

As to the method of application of the water — (*a*) thrown on from buckets, or (*b*) directed in a jet from an extincteur, the experiments showed that a given volume of water applied as a jet was decidedly more effective than the same amount of water applied by buckets without special apparatus; this was probably due to the greater force of the jet, and easier means of directing it. The Committee, however, think it well to add a word of caution as to only extincteurs of reliable makes being used, as fatal accidents have occurred from employment of those of faulty construction or unsuitable type.

The application of sand was (weight for weight) less effective than the dry powder, but it was found that three buckets full (about 144 lbs.) extinguished a fire which three tubes of "Kyl-Fyre" (12 lbs. 15 ozs.) failed to do. A similar smothering effect could probably be obtained from almost any dry inert substance in sufficient bulk.

In conclusion the Committee are confident that by far the best extinguishing agent is a plentiful supply of water applied in the manner most convenient, and that the use of dry powder extinguishers is to be deprecated as not only giving a misleading sense of security, but being practically useless for extinguishing or effectively controlling fires likely to be caused by bombs.

A description of the apparatus and arrangement is given in an appendix printed in the report, also analyses made of the contents of four samples of these tubes mainly offered on the British market. This section is as follows:

The following are analyses showing the percentage of the important constituents in four samples of fire extinguishers analysed for the Committee by the National Physical Laboratory: —

Name	Sodium Bicarbonate	Calcium Carbonate	Available CO_2
"Kyl-Fyre" Sample (1)	46.62	50.25	12.2
" " (2)	50.40	46.50	13.2
"Galvo"	42.40	.80	11.1
"Diamond"	55.44	10.25	14.5

These analyses show that if the whole of the carbonic acid available on heating were given off suddenly immediately the powder is thrown upon the fire, approximately one cubic foot of gas would be formed for each pound of powder used.

The smothering effect of this quantity of gas may be contrasted with that of the enormously larger volume of steam which would be generated by the vaporisation of one pound of water, which gives over 25 cubic feet (or over 1,600 times its volume) of steam at atmospheric pressure.*

The above findings of this distinguished British committee coincide quite accurately with those of a bulletin issued by the N. F. P. A. over a dozen years ago.

*The Committee would remark that most of the dry-powder fire extinguishers sold in this country are retailed at prices which can only be described as extortionate considering the cost of their constituents. The substance said to be the vital constituent — bicarbonate of soda — may be bought at present for 4*s.* 6*d.* per cwt., or almost exactly ½*d.* per pound. Thus the cost of the bicarbonate of soda contained in a tin of powder of the usual size could not exceed 1½*d.*, the other constituents being still cheaper.

Underwriters' Laboratories' New Hydraulic Laboratory.

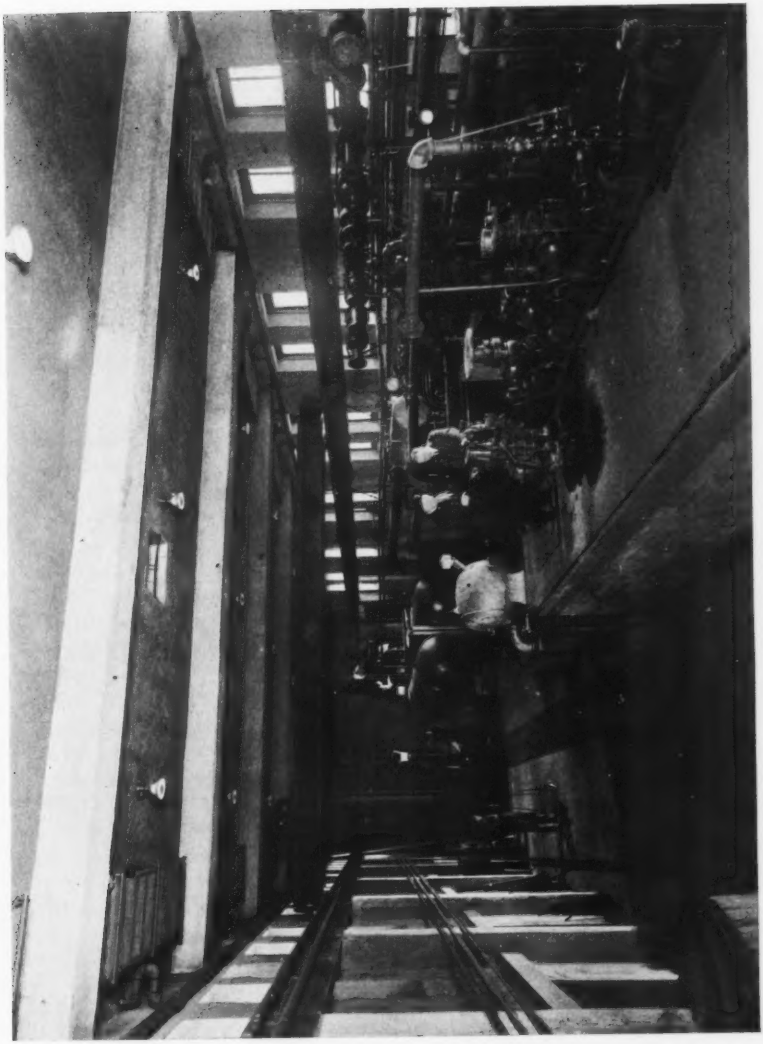
By R. W. Hendricks, Assistant Engineer (Member N. F. P. A.)

Herein is an account of the space devoted to Underwriters' Laboratories' New Hydraulic Laboratory, the equipment provided and its use, and the plans for additional equipment in the future.

Divisions of Space for Hydraulic Work.

The space allotted for hydraulic work is divided into three portions, the largest of which will hereafter be referred to as the Hydraulic Laboratory. This is 32 feet in width, from north to south; 121 feet long; and the height is 20 feet from floor to ceiling.

That part of the Hydraulic Laboratory which is to be devoted mainly to the testing of dry pipe and alarm valves, and which is commonly referred to as the Valve Laboratory, covers a floor area 19 by 30 feet, the floor of



Hydraulic Laboratory. View Looking East

this portion being formed by the roof or top of a 25,000-gallon reservoir. The height of the Valve Laboratory is 15 feet from floor to ceiling.

The other divisions consist of a Tool and Supply Storage Room and a section known as the Small Pump Room, both rooms being at the west end of the Hydraulic Laboratory. The Tool and Supply Storage Room has a floor area of 7 by 26 feet and is 7 feet 8 inches in height. The Small Pump Room covers a floor area of 10 by 15 feet and is about 7 feet 10 inches in height. These rooms are separated by a passageway, 14½ feet in width, which leads to the Hydraulic Laboratory.

Water Supply Equipment.

In water supply equipment, there is, first of all, a 25,000-gallon concrete reservoir, this reservoir being approximately 15 feet wide by 30 feet long and about 8½ feet in height. The reservoir bottom is located about 3½ feet below the floor of the Hydraulic Laboratory and the walls extend upward above this floor for a distance of five feet, and, as has been said, the roof of the reservoir forms the floor of the Valve Laboratory.

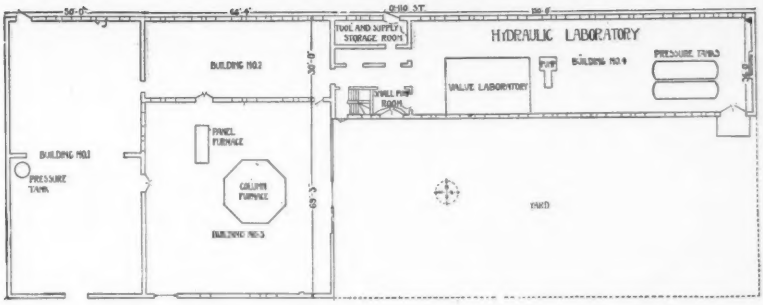
The water pumping units provided consist of motor-driven Quimby pumps of 50 and 500 gallons per minute capacity. The smaller of the two pumps is located in the Small Pump Room and the larger is mounted on a concrete foundation immediately adjoining the east end of the 25,000-gallon reservoir.

In addition to the 25,000-gallon reservoir there are one 4500-gallon pressure tank, and two 4000-gallon pressure tanks. The two 4000-gallon tanks are located near the east end of the Hydraulic Laboratory and the 4500-gallon tank remains where it has been ever since the Laboratories moved to Ohio Street; that is, in Building No. 1. The pressure tanks have been so located and connected with each other and with the water supply piping throughout the entire plant that they form the best water-supply arrangement possible. These tanks can be supplied with water either from the city mains or by means of the 500-gallon Quimby pump, this pump receiving its water from the 25,000-gallon reservoir.

The air compressors, of which there are two, form an important part of the water-supply equipment as they are employed to provide the air cushions necessary in the pressure tanks and Valve Laboratory standpipes, as well as serving to furnish air at various points throughout the plant where a compressed-air supply is needed. At present a 20-foot Christensen and a 50-foot Westinghouse compressor, both of which are motor-driven, are in use. These are installed in the Small Pump Room.

Hydrostatic Pressure Test Facilities.

The hydrostatic pressure test facilities provided consist of a motor-driven triplex pump now located on the main floor of Building No. 1 and a system of high pressure piping piped to various places in the plant, several outlets being provided in the Hydraulic Laboratory so that hydrostatic pressure tests can be conducted at convenient points. The pump has a rated capacity of one and one-half gallons per minute when working



against 5,000 pounds pressure, the rated speed being 45 revolutions per minute. The piping, as well as the pump, is designed for a working pressure of 5,000 pounds per square inch.

The triplex pump will shortly be removed from its present location and installed in the Small Pump Room, but it will still be possible to conduct tests at the old location, as a part of the present piping and test and motor control connections will be left in Building No. 1. Pump control and service outlets have been provided in Building No. 2, and these can readily be fitted up for service at any time.

Valve Laboratory.

Dealing now with the Valve Laboratory, the water main to which dry pipe and alarm valves are to be connected, and from which they will be fed, extends the full length of the Valve Laboratory, about 30 feet, and this main can be supplied with water from any of the pressure tanks or by direct pumping from the 500-gallon Quimby pump. The main is divided into sections by a gate valve placed at the middle, and the overhead piping to which valves being tested are to be connected is similarly divided. This overhead piping system is mounted along the south wall of the laboratory, and each section is connected to a standpipe which is about 75 feet in height and placed outside of the south wall.

The west section of the dry valve and alarm valve testing equipment has three 6-inch test stands and two 4-inch test stands, while the east section has two 6-inch stands and three 4-inch, making it possible to mount five devices of each size for test; and the division of the equipment makes it possible to conduct tests simultaneously upon two alarm valves, or two dry pipe valves, or upon one device of each kind.

The service main and the system of overhead piping is made up of 8-inch extra heavy piping and fittings, the size being reduced to 4 or 6-inch at each test stand, to accommodate valves of those sizes.

The overhead piping of the Valve Laboratory and the mains which carry water from the pressure tanks to various points throughout the plant are so arranged that the contents of the piping and the tanks can easily and quickly be returned to the 25,000-gallon reservoir.

Operating controls for the air compressors, the triplex pump, and the 500-gallon Quimby pump and a battery of valves controlling flow of air and water to various portions of the equipment are provided for each section of the Valve Laboratory. These controls are all grouped together in such manner that one man can readily and conveniently handle the controls for one section. The necessary pressure gauges for each of the sections are also grouped together at the control stations.

For measurement of flowing streams a specially designed nozzle meter is used and permanent piping to which the nozzle can readily be connected has been provided, in duplicate, for each section of the Valve Laboratory. The tips for the meter nozzle have discharge orifices ranging from one-eight-inch to two and one-half inches in size and rates of flow ranging from one gallon per minute up to about 2,000 gallons per minute can readily be measured. In addition to the meter nozzle a calibrated measuring tank of 250 gallons capacity is provided for measuring small flows.

Provision is made by means of permanent piping for the return of water delivered by the nozzle meter, to the 25,000-gallon reservoir.

New Features.

Features incorporated in the new laboratory that did not exist in the old are not only conveniences but also time and labor savers, and they serve in some cases to reduce wear and tear upon equipment, as well as providing additional test facilities. Foremost among these features is the crane service which is now available for the entire Hydraulic Laboratory where such service was formerly only possible for six test stands, the service being provided by a crane having a maximum load capacity of twelve tons and fitted with an auxiliary one-ton hoist.

A feature which perhaps ranks second in importance is that the valve-test stands have been made uniform and it is therefore possible by using the crane to quickly and readily transfer a valve which is being tested from one stand to another without materially dismantling and reassembling the temporary piping used to fill in the gap between the terminals of the permanent piping.

Hydrostatic pressure test connections have been provided for each test stand, making it possible to test valve bodies to the failing point without removing them from the test stand which they occupy while undergoing other necessary tests. This feature also makes it possible to conduct a test which develops data relative to the strength of dry pipe valve parts without removing the valve from the stand or doing any extra pipe fitting.

Another feature worthy of mention consists of an arrangement whereby the pressures upon the gates of gate valves used for controlling the flow of water to or from devices mounted on the test stands can be equalized, making it much easier to open the valves than would be the case if the difference in pressure on the two sides of the gate were very

considerable. This feature also makes for a reduction of the wear and tear upon gate valves which would otherwise occur.

Another interesting feature is the new arrangement of the air pumps and piping. Both air compressors were formerly connected to the same main, and consequently there were conflicts in the service when, as often happened, there were two or more simultaneous demands for a supply of compressed air. Separate headers and piping are now provided for each air pump and the air supplies are therefore normally kept independent of each other, although the piping is so arranged that cross connections can be made. Larger air mains have been installed in the Hydraulic Laboratory and these provide greater promptness of air service as well as much better pressure regulation throughout the entire plant.

Another feature worthy of mention relates to the automatic overflow with which the 25,000-gallon reservoir has been provided. With the present arrangement an ample overflow pipe and excess capacity above the overflow line of the reservoir have been provided to permit drainage of pressure tanks and piping without opening the drain which has been installed and which it is probable will never be opened excepting when it is desired to completely drain the reservoir to permit of its being cleaned. The excess capacity previously mentioned is not in any sense to be considered as waste space as the regular overflow pipe is provided with a gate valve and the reservoir is provided with an auxiliary overflow at its extreme top, so that if at any time maximum storage facilities are desired for some special service the entire capacity of the reservoir is available.

The pumps have all been grouped together in a location where they will be subject to better operating conditions and where they can all be cared for at once. The endeavor has been made to fully meet present needs and anticipate future needs in the matter of remote control facilities, so that tests can still be conducted at the points where the work was previously done or at points where it may prove necessary to do test work in the future.

Automatic regulation of the pumping apparatus, both for air and water, has already been provided for where it was considered desirable and provision has been made so that automatic regulation of pumps which are not now so regulated can readily be secured. In general, push-button control rather than automatic regulation is contemplated because of the economy of power, but in cases where two or more persons need service from the same pumps and where their demands do not overtax the capacity of the pumps automatic service can readily be had.

Other features worthy of note are the installation of permanent headers and piping, installed to facilitate and standardize the installation of water motors and gongs for alarm valve tests, and flexible priming connections which have been provided for each test stand for use in priming dry pipe valves which are being tested. This latter feature will prove a time and labor saver as well as a convenience.

Flexibility of Equipment.

One very important feature of the planning of the laboratory was that of securing flexibility of equipment; that is to say, so arranging the pumps, both for air and water, and the piping and other equipment that it is possible to readily and simultaneously provide water for use in the Hydraulic Laboratory, for use in panel and column furnace tests in Building No. 3, and also for tests at other points where comparatively large water supplies may occasionally be necessary.

To illustrate to what extent flexibility of the equipment has been attained, a few of the combinations of water supplies and piping which can readily be made and their uses are here given.

1. The east or the west section of the Valve Laboratory can be served from either the north or south 4000-gallon pressure tank in the Hydraulic Laboratory.

2. It is possible to simultaneously use both pressure tanks located in the Hydraulic Laboratory to supply either the east or west section of the Valve Laboratory.

3. It is possible to supply either section of the Valve Laboratory with water from the 4500-gallon pressure tank in Building No. 1.

4. The east or the west section of the Valve Laboratory can be supplied from the pressure tank in Building No. 1 in combination with either of the tanks in the Hydraulic Laboratory, and the third pressure tank can be used to supply the remaining section of the Valve Laboratory.

5. It is possible to supply either section of the Valve Laboratory by either one, two or three pressure tanks, and pump directly from the 500-gallon Quimby pump to supply the section which is not being served by the pressure tanks.

6. The pressure tank in Building No. 1 can be used to supply water for use in panel furnace tests in Building No. 3 without interfering with tests which may be in progress in the Hydraulic Laboratory, if proper preparation of the tank is made before water is needed, and without pump service other than for a short time during which the tank is being filled to the proper level.

7. If the pressure tank in Building No. 1 is in use, either one of the tanks in the Hydraulic Laboratory or both tanks can be prepared for supplying water for use in panel furnace tests in the manner just mentioned for the tank in Building No. 1.

8. Where tests require streams of more than one minute duration, the equipment provides for a supply at the start solely from the pressure tank in Building No. 1 to be followed up by operation of the 500-gallon Quimby pump, this pump discharging into the tank.

9. Panel furnace or column furnace tests can be supplied with water from either one, two or three tanks, the number of tanks used depending on the rate of flow necessary and the required duration of the stream or streams.

10. It is possible to have all three of the pressure tanks in use for panel or column furnace tests and at the same time supply water for use

in dry pipe, alarm valve, meter or other tests by direct pumping, by operating the 500-gallon Quimby pump.

11. In addition to the services mentioned, water can quite readily be supplied from any one pressure tank or a combination of the tanks, or by direct pumping, for tests which are more or less out of the ordinary and which require that water be available at points where it is not commonly used; that is, for tests of devices such as meters, open sprinklers, hose racks, etc.

Future Plans.

Additions to the present test facilities which, it is expected, will some day be provided are given in the following, the equipment being listed in the order of its importance when considered in conjunction with that which is now installed:

1. A 100-foot air compressor.
2. A 1,500-gallon turbine pump.
3. Additional facilities for water measurement, including one 6-inch and one 12-inch Venturi meter; a measuring tank or tanks with a total capacity of approximately 5,000 gallons; and a weir.
4. A 12-inch general service main, this to be laid in a trench extending practically the full length of the laboratory.
5. Additional hydrant testing equipment.
6. A gravity tank, placed on a tower and located in the yard. This tank to serve for supplying water for test purposes and also to supply water for the plant sprinkler and inside standpipe systems now installed or contemplated for the future.

Comparison of the commodious new quarters and the equipment provided for hydraulic work with the old hydraulic or valve laboratory shows that, among other advantages, there is now about three times as much floor space devoted to the work; much greater head room throughout; better lighting and heating facilities; better ventilation; and finally, a greater amount of the equipment which is needed and this equipment arranged in such a way as to greatly facilitate work on dry pipe and alarm valves; gate, globe, check and hose valves; hose racks and reels; hydrants; fire service meters; air and water pumping apparatus; open sprinklers; fire hose and hose fittings; and nozzles of various kinds.

Electrical Hazards

Underwriters' Laboratories (Member N. F. P. A.)

While the development and universal adoption of the National Electrical Code have eliminated most of the practices which in the early days of the electrical industry caused many fires (and were blamed for many more they did not cause) the fact remains that in electrical energy still reside all the early potential dangers, which should be sought for and overcome in all new applications of electricity - especially to domestic use. Electric wiring for lighting has been so successfully protected that we no longer look for fires and accidents from such installations in the home or office; but installations for power and heating are yet new enough to demand attention from both manufacturer and user.

The electric flat iron is a constant cause of fires in homes, tailor shops, etc., no thoroughly reliable and practical safeguarding or indicating device having yet been successfully applied to it. Certain devices designed for use on electrical circuits and which may obviously cause fires if not properly constructed and operated are described below.

Dental Panelboards.

The use of electricity in dentistry is of special interest and its development extends over a period of about twenty years. The present-day dental panelboard for use in dental operating rooms and mounted on the wall is arranged to supply and control current at a low voltage for such instruments as mouth lamps, root canal dryers, antrum lamps, ball points, wax spatulas, cauteries, hot-air syringes and similar devices. Such equipment as dental engines, lathes, automatic air compressors, furnaces, gold annealers, atomizers, sterilizers and water heaters are furnished with current at ordinary voltage from special connections on the board.

Panelboards for this purpose are of marble and are mounted on a cast-iron frame. Upon the front of the board are pilot lamps, switches, fuses, rheostats, the different air regulating attachments and the low voltage terminals. Methods of arranging these parts vary with different manufacturers, but the controlling resistances and small transformers, if any, are found either on the back of the board or in a special cast-iron case on the floor.

The wiring on the back of the board should be and usually is done either with rubber-covered or with slow-burning wire, depending upon the temperature attained here under extreme conditions. A criterion for the temperature to which rubber-covered wire may be subjected is noted in Rule 35-d of the Code, which refers to gas-filled incandescent

lamps and requires slow-burning or asbestos covering on wires where they are subjected to a temperature exceeding 120 degrees Fahr.

The maximum current rating given to dental panelboards is around fifteen amperes. Current from the supply circuit is taken by a length of standard portable cord and a standard attachment plug and flush type receptacle of the proper capacity; by standard No. 14 rubber-covered wire run in rigid conduit, and connected directly to the board or terminal box; or by some other standard method allowed by the inspection department having jurisdiction over the installation.

Further special points of interest to electrical inspectors are the use of upturned lugs or their equivalent at wire terminals; protected terminals; enclosure of the back of the board by metal, and an ample air space back of the board if mounted on a combustible surface.

The wires that connect the low voltage instruments to the board must be very flexible and light. They are generally special twin conductors constructed of finely stranded copper conductors, each insulated by a double braid of silk and held together by another braid of silk.

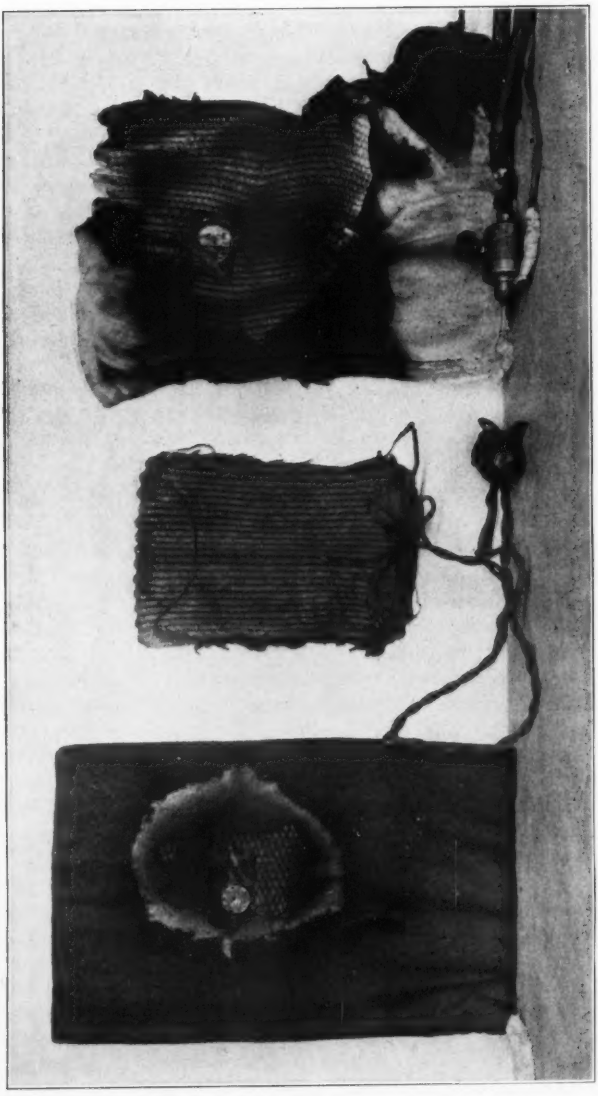
A hazardous feature about a board of standard construction is the cautery, which, when in use, has exposed a hot platinum wire at a red heat, and this is also at that time a live metal part. This instrument is used, of course, by the dentist, who, it is assumed, has a knowledge of its nature, control and use.

Electrically Heated Pads, Foot Warmers and Blankets

From time to time electric heater pads, foot warmers and electrically heated so-called blankets have been submitted to Underwriters' Laboratories for examination and test, with request for approval and favorable listing.

Such devices, when tested in the open and freely exposed to the air, might operate in an apparently safe and acceptable manner. It can readily be understood that when placed in practical service, heater pads, foot warmers and the like are covered by a mass of heat-insulating material and with continued operation the heat must necessarily rise until the radiation and conduction from the heated material surfaces dissipate the energy as rapidly as it is being supplied. Before such an equality is established, the rise in temperature is sufficient to cause the ignition of readily combustible material surrounding the heater device, and a fire is probable.

Recognizing the extremely hazardous conditions presented by the use of heater pads, various attempts have been made to provide thermostats or automatic cutout devices which will cause the supply circuit to be opened at a predetermined temperature, and which would prevent the ignition of materials and the starting of a fire. Automatic appliances of this character are somewhat sensitive in operation and are quite subject to sticking and arcing at the contacts. They are also likely to be accessible, thereby making it easy to change the adjustment and possibly raise the temperature at which the circuit will be opened.



Heater pads that have started fires.

Heater pads must be more or less flexible and cannot conveniently be of bulky or cumbersome size, and the thermostats or thermocutouts are generally not suitable for the relatively rough usage met with under conditions of actual service.

The illustrations show heater pads which actually caused fires while in use. The circumstances attending one of these fires are as follows: The pad was used to heat a bed during unusually cold weather. The heater control switch was adjusted for the lowest temperature and the pad was left in service for the night. At a later hour the person was awakened by the smell of smoke, when it was found that the bedding had been charred completely through immediately over the heater, and the mattress underneath also injured. The edges of the charred section were aglow and ready to burst into flames, but prompt action with a pitcher of water and turning off of the heater prevented what might have resulted in fire and personal injury. The following brief quotation from a letter from an inspection department presents further evidence of similar nature: "We had a fire with an electric heating pad in a private sanitarium and pretty nearly burned up the patient."

The record cards issued by Underwriters' Laboratories covering devices of this particular class bear the following statement:

"The use of any heater of this character presents certain fire and life hazards which cannot be relatively guarded against by excellence of the design and construction of the device itself."

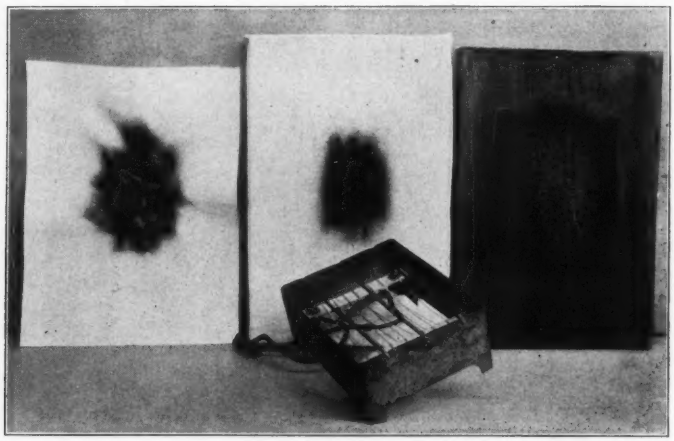
An Electric Toaster for Ten Cents!

The increasing popularity and use of electric household heating appliances has resulted in the appearance on the market of a cheap electric toaster in which the amount of material is reduced to a minimum, and the construction to the simplest form.

A toaster of this kind purchased in a ten-cent store is shown in the accompanying illustration.

This toaster is of the horizontal type and is simply a rectangular sheet-metal frame supporting several wires across the top, spaced about 1½ inches apart, and a length of resistance ribbon terminating in a pair of ordinary dry battery binding screws and looped between two narrow strips of asbestos board. The device consumes 580 watts on a 110-volt circuit.

It will be evident from a consideration of the features of construction and assembly that little, if any, attention has been paid to the hazards incident to the use of a heating device. Among these hazards may be mentioned the exposed and unprotected heating element; lack of protection from heat reflected downward, on the surface under the toaster; absence of upturned lugs or equivalent means for preventing the current supply wires from becoming disconnected at binding nuts; liability of loose strands of the supply wires coming in contact with and making the frame "alive," and the use of supply wires having insulation not designed for electric heaters.



What this ten-cent toaster did.

The photograph points out some of the effects to be expected from the use or abuse of an appliance of this character.

The toaster, with the current turned on, was placed on an asbestos pad with a single sheet of white note paper beneath and with a square of sheet asbestos the size of a slice of bread on top. The result on the paper at the end of ten minutes is shown on the left.

The toaster was next placed on a pine board with a layer of cheese-cloth beneath and a square of sheet asbestos on top. At the center of the photograph the appearance of the cheese-cloth at the end of five minutes is shown.

A third test was made by placing the toaster on the uncovered varnished surface of a pine board with a square of sheet asbestos on top. The varnish blistered in one-half minute and at the end of four minutes the board appeared as shown on the right of the illustration.

With the toaster placed on a plain, uncovered pine board, with a square of sheet asbestos where a slice of bread would be placed, flames enveloped the toaster in six minutes.

In the 25-minute period over which the foregoing tests were continued, the insulation on the lead wires adjacent to the terminals was entirely destroyed by the heat for a length of about two inches. This destruction of insulation extended far enough along the wires so that the bare strands of both wires could come in contact with the edge of the frame of the heater.

Steel or Brass-coated Iron in Electrical Fittings.

The use of steel or brass-coated iron as a substitute for copper or brass in certain electrical fittings was the subject of a conference in New York in January between about fifty manufacturers of electrical fittings and supplies and the Underwriters' Laboratories.

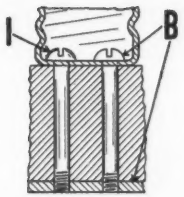


Fig 1
Screw Shell Socket.

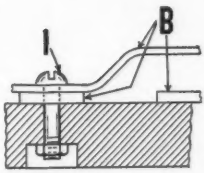


Fig. 2
Bus-Bars.

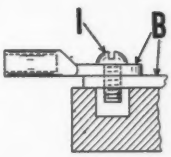


Fig 3
Lug Terminal.

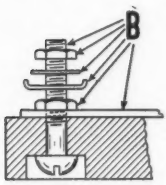


Fig. 4
Stud Terminal.
Cupped Washers.

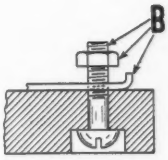


Fig. 5
Stud Terminal.
Upturned Lug.

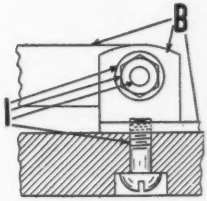


Fig. 6
Knife Switch Hinge.

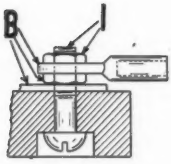


Fig. 7
Stud Terminal.
Soldier Lug.

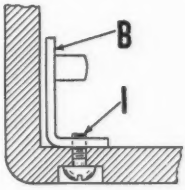


Fig. 8
Flush Swith Contact
No Straps in Base.

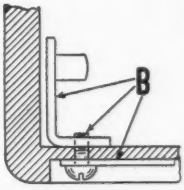


Fig. 9
Three-Way Switch Contact.
Strap Sealed in Base.

In the discussion an important point made was that electrical fittings are used in many parts of the country and in locations in which they are subjected to moisture, a condition that would create a rapid and possibly dangerous corrosion, depending upon the function of the steel parts used.

The outcome of the meeting was the adoption of a resolution reading as follows:

"Iron or steel, plain or plated, shall not be used for parts which are depended upon to carry current; or for movable wire-binding screws or nuts; or, except where soldering lugs are used, for any wire-binding screws or nuts."

"Bolts, washers and nuts at the hinges of knife switches are considered to be parts which are not depended upon to carry current."

Referring to the illustrations which serve to point out the application of the rule to some of the more usual constructions, the letter "I"

indicates that the parts may be made of iron or steel and the letter "B" indicates parts where iron and steel are not considered acceptable.

Fig. 1 shows two screws holding a single part. In general, one of these screws may be of steel, while the other should be of copper or brass to carry current. Screws which clamp two surfaces together, as, for example, two bus-bars, Fig. 2, or which clamp a lug to a strap, as indicated in Fig. 3, may be made of steel.

"Movable" wire-binding screws are considered as those which are moved in making connections and "wire-binding screws" are those at which wires are fastened, this term not applying where lugs are clamped down. In Figs. 4 and 5 are wire-binding screws, while Figs. 3 and 7 have none. Movable wire-binding nuts shown in Figs. 5 and 7 may be made of steel if they secure lugs, but not if they bind wires.

In the use of a stud terminal with cupped washers, as illustrated by Fig. 4, the stud and all nuts and washers must be made of material other than iron. In the case of a stud terminal with a solder lug, Fig. 7, the lower nut which fastens the stud to the base, if it is depended upon to carry current, must be made of brass. The stud itself and the top clamping nut may be of steel.

Bolts, nuts and spring washers at the hinges of knife switches may be of steel as indicated in Fig. 6. The kind of material in snap switches of different construction is indicated in Figs. 8 and 9.

The Printing Industry.

By W. B. White and G. Y. Lancaster, Jr. (Members N. F. P. A.)

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INTRODUCTORY

Printing naturally divides itself into three classes. Printing from a raised surface; printing from a flat or plane surface, generally known as lithography; and printing from a depressed surface, known as intaglio or photogravure printing.

The great bulk of printing is done from raised type or plates. Newspapers, magazines, books, bill heads, advertising matter, color prints and photographs are nearly all reproduced in this manner.

Next in importance comes the lithographic process. It is more used for artistic reproductions of drawings, paintings, maps, etc., than for commercial printing; it is nevertheless used for label printing, bill heads and some other forms of commercial work.

Photogravure is perhaps the most beautiful of the printing processes, and at the same time the least used, principally because of mechanical difficulties in reproduction. Most of these difficulties are being overcome, and because of the beautiful results obtained, the process is coming into more frequent use, especially in connection with the rotary press.

Closely allied and frequently operated in conjunction with the printing establishments, are the plate making processes, which include stereotyping, or making plates from stereo material; electrotyping, or making plates faced with copper, nickel or iron; and photo engraving, or making solid plates by photographic and etching process from copper or zinc.

The book binding art should properly be taken up in this connection because it takes the book sheets and produces from them a finished product.

RAISED SURFACE PRINTING.

Typesetting and Plate Making. Typesetting is done either by hand or machinery. The art of hand composition is very generally understood; headings, captions, art editions and a large percentage of advertising matter are set in this way. The great body of type for newspapers, magazines, books, catalogues and similar matter is, however, set in linotype or monotype machines.

Linotype Machines. The machines derive their name from the fact that they set up one continuous line of type, through the operation of a keyboard resembling that of a typewriter, collect a set of matrices or moulds sufficient for a line of words, spaces, etc., of the length required, and from these moulds cast a line in one solid bar. The bars are delivered

by the machines in proper sequence to a galley, from which, as they accumulate, they are collected by the operator to be made ready for the printing machines. The matrices pursue a circulatory course through the machine, starting from the mouth of the magazine and passing downward to the line in which they are assembled, thence to the mould, to produce the letters on the linotype, and finally back to the distributing bar, from which they fall into their proper grooves in the magazine. It is this circulation of the matrices, and the fact that the operation of composing one line, casting from another, and distributing a third, are carried on concurrently and without interference, that enables the machine to operate at an amazing speed. After being used, the linotypes are returned to the melting pot to be recast into other lines, thus doing away with the cost and labor of distribution.

Monotype Machines. Machines of this class cast their type singly and deliver it to the galley in line lengths, properly spaced and punctuated, but to accomplish this, two separate machines are required. The machine first used is the keyboard, which is similar to the keyboard of a typewriter, at which the operator sits with his copy, depressing the keys letter by letter, thereby punching a series of holes in a paper in the form of a ribbon, fed from a reel through the machine. The perforated paper is then taken to the casting machine, and operates it in a manner similar to a mechanical piano. This machine comprises a mould block for the casting of the type, mounted immediately above a gas-heated metal pot, which is fitted with a pressure pump. The mould block, containing two hundred and twenty-five characters is shifted forwards, back and sidewise by levers working at right angles to each other, its final position being determined by pins, the pins for the desired letter being raised by compressed air passing through the perforation in the paper roll which was previously made by that letter on the keyboard. As the type is cast it is conveyed into a channel, each succeeding type pushing the others into the channel leading to the galley. When the galley is full it is removed and an empty galley fitted in its place, without stopping the machine. The type is cooled by means of a continuous current of cold water passing through a channel surrounding the casting chamber of the mould.

In plants where the amount of composing is extensive, automatic type-casting machines are often employed for replacing worn or lost type. The mould for the type desired is placed in the machine, and after starting will continue to cast a particular type until stopped. Where machines of this kind are used, it is customary to find a lead pot, generally gas-heated, for casting slugs of type metal for the machines.

Stereotyping. Is generally employed to make the plates for rotary presses, although it may be used for flat plates. The flat form is removed to a table and a sheet of thick specially prepared paper is moistened and laid over the face of the type. The paper is then beaten with a large brush, or placed in a press, so that it is forced over and about the entire type surface. The result is a matrix of the type. When the matrix has been satisfactorily made, it is placed on a steam table to dry and when

removed is still flexible enough to be bent to the desired shape. The matrix is then put into a casting box, which when closed forms a mould in the shape of a half cylinder with the matrix for one side. The remaining space is then filled with molten type metal, which when hard, is removed, trimmed and grooved, and placed on the press ready for printing.

In the larger establishments, especially in newspaper printing, where time is of great importance, the operations involved in turning out a finished plate from the matrix, are combined in a machine known as the Auto-Plate Machine.

Electrotyping. Electrotyping is the manufacturing of plates faced with copper, nickel or iron, whose surface is the exact facsimile of an original, which may be a form set up of type, a stereotype plate, a photo engraving, a wood cut, a hand engraved plate, or similar surface. Electrotyping derives its name from the fact that the process is in substance electroplating a wax impression of the subject to be reproduced.

For large editions, where a type form or stereotype plate would become worn and prints faulty, the copper-coated electrotype will give good results; where the edition is very large, the nickel or steel-faced plate is used on account of its harder surface and better wearing qualities.

The operations of making an electrotype plate are as follows: The first step is to make an impression of the plate or cut in wax. The wax is heated in steam, gas or electric heated kettles and when in a liquid state is poured on a backing plate of copper, generally about 3-16 of an inch thick. To prevent the liquid from running over the table, metal bars may be laid around the plate to form a rim. This gives a backing to the wax so that it can be handled. The backing plate is then placed on a planing table and the wax shaved to a uniform thickness. The form or plate to be copied is placed on a press, which may be steam or gas-heated, the backing plate placed upon it, wax side down, and sufficient pressure applied to force the wax thoroughly into the surface. Between operations, the plates are placed in steam or gas-heated warming closets to keep the wax in a plastic state. The wax now has printed into its surface an exact intaglio of the form; this is coated with graphite in a graphiting machine. The latter either dusts graphite over the surface or washes it with water carrying large quantities of graphite in suspension. The graphite is to form a conducting coating so the surface can be electroplated. The edges of the plate are melted to remove the graphite from them and prevent plating on the back. In starting the electroplating process, the surface is dusted with iron filings and immersed in a copper sulphate (blue vitriol) solution. Each particle of iron forms with the graphite a miniature voltaic cell, and results in quickly coating the surface with a film of copper. Some firms omit this preliminary plating. It is then removed to the plating bath, connected with the electric current and plated. The time of plating depends upon the class of work. A rapid plating tends to make the copper soft; a slow plating gives a denser and better wearing surface. When the copper is of sufficient thickness and strength the plate is removed, stripped from the wax, cleaned and dried.

In backing the thin copper impression with stereotype metal for stiffening, a great deal of care is necessary to make the metal flow into and support all the little edges and corners. First the copper is placed face down on a steel plate floating on the surface of the molten metal. This heats it to the temperature of the stereotype metal. The inside is first tinned, which fills up the corners and permits the stereotype metal which follows to flow over and adhere properly to the copper. After the plate is filled with the stereo metal, it is allowed to cool and is then ready for the finishing processes. These consist in placing the plate face down on a planing table and planing it to uniform thickness, sawing or bevelling the edges, routing out the design where necessary, bending it to fit a cylinder press, or backing it with wood of the right thickness for use in a flat bed press.

Photo Engraving. Photo engraving is the preparing of plates for printing reproductions of photographs, drawings, designs, or any other subject by photographic and etching process.

In brief, the process consists of taking a photograph of the subject. From the negative thus obtained, a print is made on a plate of copper or zinc, covered with a gelatine or albumen film, sensitized with bichromate of potassium or ammonium. This print is then etched with acid, the plate being eaten away in inverse proportion as the light penetrates through the negative, leaving the picture in relief.

Photo engraving is one of the most important of the useful arts. Practically all illustrations, whether photographs, pen and ink, charcoal, line or mechanical drawings in our magazines and books of today, are reproduced by this process, which reproduces with accuracy to the most minute detail, and lends itself in the most convenient way to the enlargement or reduction of the subject to fit the given page To this art is due the number and excellence of the illustrations of the present, as compared with the scanty and poor wood cuts, and beautiful, but exceedingly scarce, steel engravings of former days. The magazine cover designs, beautiful in varied colors, as well as other colored pictures, are mostly printed from color plates made in the photo engraver's shop.

As the artistic feature of this business is a prominent one, good light is much sought after and the photo engraver's place is most frequently found on the top floor of buildings, where north light may give an abundance of diffused daylight. The floor is divided into various sections by partitions, for offices, artists' quarters, photographic department including dark rooms, rooms for coating and washing plates, etching department where the metal plates are coated, printed and etched, and a finishing department where plates are trimmed, bevelled and backed.

The first step of the process is to photograph by daylight or by artificial light the subject to be reproduced. Generally electric arc lights are used, although mercury vapor lights are occasionally found. Artificial light is frequently used to the exclusion of daylight because of its greater uniformity. The plates used may be wet collodion or dry plates. Until recently wet collodion plates were used almost exclusively, and are

still preferred for line and half-tone plates from black and white originals. Collodion plates are coated on the premises; the collodion is sometimes made on the premises from soluble gun cotton and ether, but more generally is purchased ready made. As there are three stages between the original and the printed illustration (the negative, the print on the plate and the print from the plate to the paper) the final print will be reversed from right to left if the negative is taken the usual way. Some process cameras are therefore fitted with a right angled reversing prism in front of the lens; otherwise after the negative is finished the film is coated with rubber cement to strengthen it, then it is stripped from the glass and reversed. If the original is a photograph, a ruled glass screen (known as a half-tone screen) is placed in front of the plate, which breaks up the light into a succession of dots, of intensity varying with the light and shade of the original. After exposure the plate is developed, washed and dried according to the usual procedure of making a negative.

A print is made from the negative on a plate of zinc or copper covered with an emulsion usually composed of albumen mixed with fish glue and sensitized with bichromate of ammonium. The solution is flowed over the plate which is then whirled over a gas burner or stove until thoroughly dry.

After printing the plates are washed, which dissolves those portions not affected by light. The parts which remain are dyed to show the design clearly. The next step is to guard the design against the etching acid. After printing the plate is inked with a roller and then immersed in water. After a few minutes it is gently rubbed with soft cotton, all the unprinted and therefore soluble portions being rubbed away, leaving the design protected with ink. The plate is dusted with an acid resisting powder which will adhere to the inked portions only, then burned in over a gas flame. The back of the plate is coated with shellac to protect it from the acid and the plate is ready to be etched. The etching is either done in an etching machine spraying the acid against the surface of the plate, or in rocking tubs operated by machinery. Zinc plates are etched with nitric acid and copper plates by iron perchloride. The plates are left in the solution until any further action would undercut the edges of the design. They must then be taken out and the edge of the design protected. The usual method is to hold the plate in a slanting position and dust dragons blood or other acid resisting powder over it. The powder banks on the upper edge of the design and is burned in over a gas stove, the process being repeated for all four sides of the plate. The plate is re-etched and the edges reburned as many times as may be necessary to fully develop the image. It is proved on a proof-press and if imperfect may be touched up by hand or re-etched locally, the balance of the plate being protected with asphaltum. Low places may be routed out and the plate trimmed, bevelled and backed, when it is ready for delivery to the customer or printer.

Color Plate Making. Perhaps the highest development of the photo engraver's art is the making of plates for color prints. To do this suc-

cessfully, the engraver must, in addition to his skill in producing light and shade, know the theory of color, the results of mixing various colors, how to choose and select pure inks in proper colors and to so make his plates that they accurately register or superpose one over the other. The results, if properly done, are wonderful in their brilliancy and beauty or, if poorly done, tragedies in crude and degraded color.

The tri-color process is the most used. It is based upon the theory that light is composed of three primary colors, the proper admixture of which will give any color, tint or shade desired. As the application of this theory is intricate and difficult to understand, it will not be here given, this discussion being confined to actual operations.

Three photographs are made of the colored subject to be reproduced, one with a purple ray filter to shut out the yellow rays and allow only the red and blue rays to pass through; another with a green filter to shut out the red rays and allow the yellow and blue rays to pass, and the third an orange filter, which will shut out the blue rays and allow the red and yellow rays to pass. The filter or ray screen is placed immediately in back of the lens. In these operations the position of subject, lens or plate must not be changed if the finished plates are to register properly. The photographic plates are specially sensitized for colors and the development must be conducted with special dark room lights. Prints are made of the color record negatives thus obtained, which are then rephotographed, using a prism for reversing the image, and a half-tone screen for breaking the image up into dots and spaces. Stripping the film to reverse the image cannot be done, as the stretching of the film would make the register faulty. The half-tone screen is turned through an angle of sixty degrees between each photographing, so as to avoid showing a pattern in the finished print. From this second series of negatives the copper plate engravings are made, as described above. The photo-engravings could have been made from the first series of negatives, but on account of the long and uncertain time of the exposures due to the colored light and the interposed prism and half-tone screen in the direct process, and the additional opportunity for retouching intensification or reduction of negatives or prints in the indirect process, the latter is mostly used.

When it comes to printing, the plate made from the purple filter is printed in a bright yellow ink; upon this is accurately superimposed a print made from the plate taken with the green filter in a crimson ink approaching a magneta; lastly a print in blue is made from the plate taken with the orange ray filter. The result is a print approximating the original in color and brilliancy, if the work has been skillfully carried out. A fourth printing is frequently made to secure depth in the shadows, with a plate using a warm or cold black or gray ink or any other color required to give the desired effect in the picture.

Not all color printing is conducted as outlined above. Where the colors are few and outlines fairly well defined, photo engravings may be made in the usual manner for the desired number of colors, and the portions

not desired to be printed in those colors etched or routed away, and local re-etchings employed until the desired result is obtained.

It will be readily seen that a large part of the credit for successful color printing lies in the skillful underlaying or overlaying, the selection of colors and the registering by the printer.

Printing and Presses. Small editions and small work are usually printed on a job press; the latest development of which is the self-feeding automatic feature. Large subjects are printed on cylinder presses, where the plate is carried on a reciprocating flat bed and the paper is brought in contact with it by a cylinder. Type forms, flat lead electrotypes and zinc or copper engravings can be printed therefrom. A flat-bed press will print from 1,100 to 1,800 copies an hour.

For large editions the rotary press is employed, especially in newspaper and magazine printing, because of the speed with which copies can be turned out. The paper is fed to the press in a continuous web from large rolls, and each copy is automatically cut and folded before leaving the press.

Magazine Printing. Magazine publishing comprises such a large and very important branch of the printing business that an outline of the process might be of interest.

The manuscript is sent to the composing room where the body of the material is set up on typesetting machines, and the headings, advertisements, etc., by hand. This material together with the engravings for illustrations is made up into forms the size of a magazine page, proof-read and sent to the electrotype department. Here electrotypes are made (as described elsewhere), planed to an even thickness and bent and beveled to fit a rotary press. The magazine press resembles somewhat the Hoe newspaper press, except the cutting and folding portion. Instead of producing a single folded sheet it produces six folios, each the size of a magazine page. These folios are kept in separate stacks and removed to the gathering machine in which they are placed in the proper number and order required to make the magazine. The machine collects the folios which are fastened together by a wire stitcher. The covers are printed in color on flat bed cylinder presses, often of the two color type and are cut to size and attached to the rest of the magazine in a separate automatic machine. The hazards of the process are identical with those described elsewhere, except the backing machine, which may have the glue pot gas-heated.

FLAT SURFACE PRINTING — LITHOGRAPHY.

General. Lithography is the art of printing from a plane surface. The term "Lithography" is derived from the Greek and signifies "Writing on stone"; it is appropriate because from the time of its invention to the present, the great bulk of lithographic printing has been done from the surface of a certain type of limestone quarried in Bavaria and known as litho stone. The use of zinc and aluminum plates is now superseding to

some extent the use of the more bulky stones; the process however, is substantially the same and the term "lithography" is accepted as covering the whole art.

Lithography was invented by Alois Senefelder, a German, in the year 1798. Twenty years later when in danger of losing the credit of his invention to some of his competitors, he wrote a book describing the process fully, and so thorough had been his investigations and experiments that the process is substantially the same to-day, and his book could well be used as a textbook by the modern lithographer.

The applications of this art are wide. It is used for show card and label printing; for small editions of designs where it would not pay to make the more expensive copper or zinc plates; for post cards; for a great variety of color work, ranging from the crude advertising or theatrical poster to splendid reproductions of drawings, paintings, etc. Its advantage lies in the ease with which the stones can be drawn upon or otherwise prepared.

Process. It is frequently a mystery to an uninitiated observer watching the operation of a lithographic press, why the ink roller passing over the flat surface of the stone, spreads ink upon the design only, leaving the rest clean. The explanation of this phenomenon is the basic principle of lithography. It is the affinity of fatty or resinous matter for substances of their kind and their repugnance to water. When a drawing is made on the stone with lithographic crayon or ink and all other parts of the drawing are moistened with water, these substances will penetrate their own particular portion of the stone. A roller covered with ink, passed over the stone, will apply ink to the ink or crayon drawing, but the ink will be repelled by the wet portion; this portion will therefore remain black and the printed reproduction will be of the design only.

The drawing to be lithographed is laid out upon the stone with a specially prepared ink or chalk composed of soap, wax, lard and shellac, with black added as a pigment, or it may be drawn upon transfer paper and transferred to the stone. The surface of the stone is etched first with a nitric acid and then a gum arabic solution, or sometimes the solutions are combined. This is not etching in the sense that a copper or zinc plate is etched, for the depression it leaves is scarcely appreciable. The function of the nitric acid is to render the ink or crayon insoluble by dissolving the alkalis from the soap, thus preventing it from spreading; the gum arabic fills the pores of the remainder of the stone, making it retain the water better; some authorities claim this action is assisted by the combination of the nitrates left by the action of the nitric acid on the stone with the gum arabic to form an insoluble compound. The stone is washed first with water to remove the excess of gum, then with turpentine to remove any unnecessary fat from the design. When the stone has been repeatedly rolled with ink and moistened with water it is ready for the press. The lithographs are usually printed on a cylinder press equipped with two sets of rollers, one for water for moistening the stone and the other for inking the design.

Chromo Lithography. This is the art of printing in colors from a plane surface. It is not different from ordinary lithographic work, except that a separate stone and a separate printing is required for each color and the paper must be so accurately placed in each printing that each successive color will fall exactly in its appointed place. To accomplish this, the whole drawing is first made on a keystone upon which the division of the colors is clearly indicated. From this stone tracings are made of the section to be printed in each color and carefully laid out on the stones; or prints may be made from the keystone in some non-greasy medium which will not sink into the stone, and then transferred to the several color stones. The artist draws on each stone with litho crayon, the portion of the design to be printed in the color which the stone represents. The remainder of the drawing is then removed and the stone etched and rolled with ink of its respective color, exactly as for work in black. The order in which the colors are printed varies. Generally it may be said that transparent colors are printed over opaque ones; warm or cold colors are printed first or last, according as the effect desired is cold or warm.

Bronzing. The portion of a subject to be bronzed is first printed with a suitable ink or size in the usual way. Before this ink has a chance to dry the sheets are passed through the bronzer which dusts bronze over the entire surface; the bronze will adhere, however, only to the sized portion. If there are several printing operations on the sheet the bronzing is usually the first, otherwise if all the ink is not entirely dry, bronze may adhere where it is not wanted.

Photo-lithography. The application of photography to the preparation of litho stones is based on the fact that gelatin or albumen sensitized with bichromate of potassium or ammonium is rendered insoluble where affected by light. Coupled with, and proportional to this insolubility in water, is the ability to absorb and retain ink. This exceedingly convenient phenomenon is made use of as follows: The subject to be reproduced is photographed on an ordinary wet or dry plate. From this negative a print is made upon paper coated with gelatin or albumen sensitized with bichromate. After printing the paper is dampened and the sensitized face is covered uniformly with transfer ink; it is then floated face up upon water approaching boiling temperature. After soaking a few minutes, the inked side is sponged gently with warm water until all the portion not affected by light has been removed, leaving the image outlined in transfer ink. The print is then rewashed until all of the soluble bichromate has been dissolved. The inked print may then be dried, when it may be transferred to the litho stone or metal plates in a transfer press like any other drawing, etched, rolled with ink and printed.

Collotype. A sheet of glass is coated with bichromated gelatin and printed from a negative on the surface; then the gelatin is hardened by exposure to light for a short time through the back of the glass. After washing, the film is not subject to any further influence from light. Mois-

ture is then applied and the more deeply exposed portions resist the water; the rest absorb it according to exposure. It is then inked with a roller, the dry portions receiving the ink, the others refusing it more or less in proportion to the amount of moisture previously absorbed. It may then be placed in a press and prints taken from it similar to litho stone. On account of the fragile quality of the medium in this process great care is necessary and editions from the same are limited.

Metal Plate Lithography. For many grades of lithographic work, zinc or aluminum plates are superseding the use of stones. These plates are light, easy to handle, not bulky to store, low in first cost and can be used on the cylinders of a rotary or offset press. Such a press equipped with automatic feeder will give a production of 3,500 to 5,000 prints per hour as against about 800 prints from a flat bed press using a stone. The process of preparing the plates is as follows:

The zinc plates are surfaced in a ball grinding machine, then clamped in the trough of the machines, covered with ground flint and glass balls and subjected to a rotary motion. This takes the glaze from the surface, giving it a frosted appearance to the naked eye and a porous character like a sponge when examined under a microscope. The drawings, first made on a stone, are taken on transfer paper with transfer ink and transferred to the surface of the zinc, which, owing to the porous character of the surface it has been given, will absorb the ink exactly as does the litho stone itself. The surface of the zinc plate is etched with acetic or nitric acid and gum arabic solution in a similar manner to the stones. After alternate rollings of ink and washings with water or dilute gum arabic solutions, the plate is ready for printing, and is bent around the cylinder roller of the press. In printing, the plate first comes in contact with the wet rollers fed from a tank of water containing a little chromic acid, then with the ink rollers, which ink the portions that have refused the water, and also roll off any excess of water. The design is then printed from the plate to a rubber cylinder, which in turn prints the design on the paper.

Lithographic inks are generally received by the printer in paste form. The ink is thinned with litho varnish (a refined linseed oil) and turpentine. For cleaning, the prevailing fluid used on the stones is turpentine, while rollers and other parts are cleaned with turpentine, substitutes for turpentine and kerosene. Benzine substitutes are also used, as well as benzine itself.

Photo Lithography on Metal Plates. In this process the photograph is taken and the film reversed as in photo engraving. The zinc plate which has previously been ground in a ball grinder, is coated with an albumen and bichromate solution and printed from the negative. It is rolled with ink and placed in water. The portions not affected by light are soluble and can be washed away. The plate is again rolled with ink and etched with gum arabic and acid, leaving the design slightly raised, and after successive rollings is ready for printing.

DEPRESSED SURFACE PRINTING — PHOTOGRAVURE OR INTAGLIO PROCESS.

General. A photogravure is a print made from a plate in which the ink is held in depressions instead of on raised portions. In printing the depressions are filled with ink and the raised portions cleaned, the paper being forced into the depressions to obtain the print. The photogravure is a soft beautiful print of much finer quality than can be obtained from raised plates, but on account of certain inherent difficulties in making the plates and printing from them, they have been but little used in comparison with raised plates. A revival of this beautiful art has come lately and the difficulties in large measure have been overcome, and strange to relate, this revival has not been in the realm of reproductions of photos and printings to which this art seems particularly adapted, but in the illustrated supplements of our newspapers. As this work is done on a rotary press and the procedure is essentially the same as for flat plate printing, we will outline the former process only. In rotary photogravure or intaglio printing the essential feature is that even in the deepest shadows there shall be a web of metal to form a support for the metal wiper which is used to remove the surface ink. This is accomplished by using a half-tone screen which differs from the one used for raised plate printing in that the lines are clear and the dots black squares between; the lines run at forty-five degrees to the axis of the cylinder and form the required bearing for the wiper. In printing these lines are wiped clean but the ink in the pockets by its own elasticity and the pressure of the paper will obliterate them, forming those rich velvety shadows so characteristic of the process.

Process. The first step is to turn or grind and polish the copper cylinder, to clean it with potash followed by sulphuric acid, and cover it with a substratum of gelatine hardened by chrome alum.

A print is made on carbon tissue sensitized with bichromate of potassium from a reversed positive of the original. The half-tone lines must be present on this print. The simplest of several methods is to expose it for a short time through the half tone screen. The carbon tissue is then brought in contact with the surface of the cylinder under cold water and rolled securely into contact. The paper backing is removed and the tissue developed in warm water, leaving the roll covered with a film of gelatine, thin in the shadows and increasing in thickness toward the high lights. After the margins have been painted out with asphaltum and the gelatine thoroughly dried, the cylinder is ready to etch.

The first etching is performed by rotating the cylinder in an iron perchloride solution containing so little water that it will penetrate only the thinnest part of the gelatine, thus etching the deepest shadows. Successive etchings are made for the half tones and high lights using more dilute solutions which penetrate the thicker portions of the film, until the image is a perfect intaglio of the original, care being taken to preserve the screen lines in the shadows on which so much of the success of the

process depends. The asphaltum is cleaned from the margins and any remaining gelatine from the rest of the cylinder, and it is ready to be placed in the press.

The Mertens process differs from the above in that the cylinder is coated with a film of glue sensitized with bichromate of potash. A positive is made from the original using a photogravure half-tone screen. The film of this positive is stripped and placed over the sensitized surface of the cylinder and printed by lights arranged uniformly along the length of the cylinder, the latter being rotated slowly and evenly. The glue coating may then be burned in and etched with perchloride in a similar manner to the photo engravings described elsewhere.

Printing. In the press the copper rollers revolve in a trough of ink thinned to the proper consistency with solvent naptha, xylol or similar substance; the excess of ink is removed by a roller and the balance by a metal wiper or "doctor". The paper passes through the press in a continuous web from large roll, and is printed on both sides, folded and cut. To dry the ink quickly presses are very likely to be equipped with gas heated rollers or to have a steam, gas or hot water-heated oven which the paper passes through.

BINDING.

The stock of the binders' shop is the large printed sheet from the presses, each side containing a number of pages so arranged that when folded each page will appear in its proper consecutive order. The sheets are run through a folding machine which folds them to the desired sizes; the folios thus formed are assembled by hand (usually by girls), or in a gathering machine, in the proper order to make a book, and the collection passed to the book-sewing machines where they are sewed together. From the sewing machines, the product which is now in book form is passed to the "smashing" machine, which is nothing more nor less than a heavy press used to reduce the somewhat loosely folded and sewed aggregation of pamphlets into a compact, neat form. The embryo book is then trimmed in a machine which differs from the usual cutter of the printers' trade in that it has blocks above and below to securely hold the books during the cutting. The book is then placed in a horizontal press for gilding or marbling.

Gilding is done by placing the book in a press, carefully smoothing the edges, applying a proper sizing and applying the gold leaf. Cheap editions are sometimes given a gild by applying bronze powders in a special machine. Marbling is accomplished through the medium of thin glue placed in a vat through which is run a variety of colors in curious patterns by means of a rake or comb. The edges of the book are then dipped and on being withdrawn retain the pattern formed by the various colors.

The back of the book is pasted with glue to help bind the pages as well as to form a size for attaching the back, by hand or machine, and the book is passed through a rounding and backing machine which, as its name indicates, gives the book its typical rounded shape. In the

meantime the covers are being made. If the book is a cloth-covered edition, such as forms a large percentage of the present day publications, the cover is made by a casing-in machine. This machine takes cardboard on one side in three pieces, one for the back and two for the sides, and cloth at another side, neatly pasting them together, glue for this purpose being usually furnished by a gas-heated glue pot. The backs are then printed with the name or title design in a job press, embossed in gas or electrically-heated embossing presses, and then attached to the books by hand. Of the finer grades of books, part or wholly leather-bound, a large part of the process is hand work, the casing-in machine being frequently used, however, on account of its neatness and efficiency. In this latter class of books, leather-paring or sanding machines are frequently used to trim down the edges, so as to paste neatly, without ridges.

STORAGE IN PROCESS.

Practically all printing and binding houses have storage of paper and varying stock of printed matter; this is particularly true of printers and binders for publishers. The former will usually retain the printed sheets to form the books, until such time as the edition is ready for binding. The latter on receiving this stock usually retains it until the edition is completely bound. Oftentimes these stocks accumulate in large proportions, and in the publishing houses especially, they are often very large and very valuable.

SPECIAL HAZARDS.

Typesetting Machines. The hazard of these machines is light. The melting of the lead is usually done by means of gas burners, the gas brought to the machines through rigid pipe connections, but some flexible rubber tube connections are, however, necessary, and some of the inherent dangers of this method of connection occasionally assert themselves. In some cases electric heating is used, and is the better arrangement. The machines should preferably be mounted on incombustible floors; where the floors are wooden, they should be covered with metal on account of the hot metal that drops from the machines.

Stereotyping. The furnace and drying tables constitute the principal hazards in stereotyping. The furnaces are heated either by coal or gas fuel, with a large kettle directly over the fire for melting the metal. Furnaces without legs should be set on incombustible floors. If set on floors in a building of wooden construction, they should preferably be placed on concrete or brick arches between steel beams. When this is not done, a foundation should be provided consisting of sheet metal or 1-8 inch asbestos covered with two courses of 4 inch hollow tile, or its equivalent, in turn covered with at least 3-16 inch boiler iron ash plate or pan.

Furnaces with legs providing an air space of not less than four inches between the ash box or bottom of firing chamber and combustible floor, should have the combustible floor protected with sheet metal or 1-8 inch

asbestos covered with 4 inch hollow tile, or its equivalent. Lateral clearance from combustible material should be at least three feet. Smoke pipes from coal or gas-heated kettles should be substantially constructed, with ample clearance from combustible material, and connected to flues of solid masonry at least eight inches in thickness. Over gas-heated furnaces, where a separate connection is not provided for the combustion chamber, or where there is insufficient overhead clearance to combustible material, substantial hoods and vent pipes with ample clearance should be provided.

The steam table presents the ordinary steampipe hazard, and should have a clearance of not less than one inch to woodwork, and be kept free of rubbish or inflammable material.

Electrotyping. The wax for the impressions is heated in kettles by steam, gas or electricity; occasionally coal fuel is used. Where direct fire heat is used, the kettles should be water-jacketed; otherwise the hazard may be somewhat reduced if the kettles are provided with safeguards to prevent any possible overflow coming in contact with the flame or endangering other combustible material. Such kettles should preferably be enclosed in a separate fireproof room, cut off by fire door, and the sill under the fire door raised sufficiently to prevent overflow of the contents extending beyond the room. Kettles should be provided with covers having long handles for prompt smothering of the flames therein. Foundations under direct fire-heated kettles should be constructed in a similar manner to the foundations under stereotyping furnaces. The hazard of steam or electric-heated kettles is slight.

Tables where pouring is done should be of metal and warming closets to keep the wax in a plastic state during operations should also be of metal. Kettles for the stereotype metal should be arranged in a similar manner to those for stereotyping.

Hand tools generally heated over a gas stove are used for building up portions of waxed plates, and the work should be done on metal tables as the wax frequently catches fire from the heat of the tools. Gas stoves should be properly mounted and care exercised to periodically remove any excessive accumulation of wax around them or on the working tables. Sulphuric acid is used as an ingredient in the electroplating baths. Nitric acid is sometimes used to clean the plates, and hydrochloric acid to make the soldering solution preliminary to tinning the plates. A small amount of woodworking is necessary to form mountings for the plates.

Electric current at a difference of potential of about six volts is employed in the electroplating process, generally furnished from an independent generator run by motor or belt from shafting. This low voltage normally would not involve any special hazard were it not for the fact that frequently the wiring is done in a careless manner. The conductors should be of sufficient size to prevent overheating and installed on porcelain insulators and so run that a short circuit of the wires will not expose combustible material.

Photo Engraving. Perhaps the most worth-while way to discuss the numerous — though not necessarily serious hazards of this process — is to take them in chronological order. The first encountered is collodion, used to coat the wet plates. Collodion is soluble cotton (pyroxylin or gun cotton) dissolved in equal parts of sulphuric ether and grain alcohol. The explosive nature of dry gun cotton is well known. It should be dissolved at once or kept in minimum quantities and stored outside or in a locked container in charge of the employe making the solutions, who should be responsible for its care. The hazard of the collodion solution is practically that of the solvent, which is a volatile inflammable liquid having a flash point between that of alcohol (+61° F.) and that of ether (-29°F.) so that the necessity of keeping it well away from all open lights or fire is apparent. In large cities the collodion can be purchased ready made from the wholesale drughouse, which obviates the necessity for storage of dry gun cotton, ether and alcohol in the plant.

The hazard of the dark rooms lies almost entirely in the pernicious practice of making the dark room colored lanterns by placing paper over incandescent light bulbs. Such paper will always char and will frequently ignite. A metal dark room light with proper glass slides is not expensive and is a convenience to the operator.

For rubberizing preparatory to stripping, rubber cement thinned with benzol is used. As the cement must be absolutely clear and of uniform consistency, it is not practical to use the rubber cement safety pot. Safety cans may be provided for the benzol which will minimize the hazard to some extent, but it is more usual practice to accept the presence of a gallon each of rubber cement and benzol, along with the ether and collodion, as among the inherent hazards of the process and insist that rubberizing or thinning be carried on only in rooms where there are no open lights nor fires.

The moisture is frequently dried from plates after development by gas or steam heated ovens, or over open gas stoves, particularly in establishments doing rush work, such as cuts for newspapers The hazard is slight as the heat must be low to avoid spoiling the negative. Gas heated stoves or ovens should be mounted on stands constructed solely of metal, or hollow tile to raise them four inches above combustible tables, and should be provided with rigid iron pipe connections. Diligent inquiry should be made to ascertain if these stoves are used to hasten the drying of the rubber stripping coating.

The glue and albumen sensitizing coating for the zinc or copper plates is spread and dried by whirling over a gas flame in a box of metal or wood, which becomes coated with glue thrown off by the centrifugal force. While it is true that the glue ignites only with difficulty, yet on account of the proximity of the gas stove, it is essential that the enclosure be of metal.

The nitric acid used for etching zinc plates should be stored on cement floors or in lead or masonry-lined troughs only, and some sort of a rocking device should be employed for the carboy to avoid spilling and minimize

the danger of breakage. Burlap stopper covers should be destroyed when removed. Hydrochloric or sulphuric acid are sometimes used in lieu of the nitric acid. The condition of the acid etching machines should be examined. Iron perchloride solution for etching copper is non-hazardous.

Gas stoves are used for burning in the edges of plates and for a number of other purposes. These stoves should be set on stands constructed entirely of metal or on metal stands raising them four inches above combustible tables and rigid iron pipe connections should be employed.

Bichromate of potassium from its composition ($K_2Cr_2O_7$) would be expected to be an oxidizing agent and consequently dangerous when heated in contact with organic matter. Such is not the case, however, the oxygen atoms being held too securely in combination. In the artists' quarters shellac, asphaltum and benzine are used. The latter should be and is generally used from safety cans, and the stocks should be kept outside as elsewhere indicated.

The partitions in the photo engravers' premises at present are almost universally of wood. As a very real hazard is present in many of the processes, it is desirable that these partitions should be of incombustible material, so that fire starting in any one section might be confined there and have a minimum quantity of fuel to feed upon.

Lithography. The hazards of lithography are relatively less than other of the printing processes. In the preparation of the stones, nitric acid is used, which should be stored and handled as prescribed under "Photo Engraving". The quantity of turpentine for washing the stones should be limited to five gallons, except in the very largest plants. In many lithographic establishments the turpentine is used from safety cans. The more common usage is to keep the turpentine in open-mouthed bottles so as to be readily flowed over the stones. The hazard is analagous to that of ordinary painting using a turpentine thinned paint. Care should be taken that there are no swinging gas lights nor gas stoves too near the process. Steam or gas-heated ovens are sometimes used to warm the litho stones for special process work. A desirable construction for such ovens is to make them entirely of metal; double walls filled between with some non-combustible insulating material are preferable to economize heat. The heat in such warming closets must be gentle in order that the stone may expand evenly, and the hazard is slight.

Lithographic ink or litho varnish is a pure highly refined grade of linseed oil. Owing to the more volatile constituents being removed (this is sometimes done by actually burning them off), the oil is less flammable and also less liable to spontaneous combustion. The colors used are received in metal cans in paste form and thinned by the printer to the right consistency with litho varnish; larger plants may have a color mixer.

Label Varnishing is a hazard occasionally but not generally found in lithographing plants. It consists in coating the label on the printed side to give it a gloss, in a machine which, after covering one side of the label with varnish by a cylinder dipping in this varnish, delivers the label

on a belt which carries it into an oven or over steam coils to dry. If litho varnish is used, the hazard is not serious; if however, as is frequently the case, a varnish substitute composed of resin, linseed oil, benzine and other ingredients is used, the hazard is material, and the process should be enclosed in a well ventilated fireproof room preferably with outside entrance, or if communicating, having opening protected by standard fire door. Fire heat should not be used in any case.

Seasoning Paper. A mild hazard is sometimes present in printing plants in the form of seasoning rooms where paper is dried, aerated or dampened. In some the paper is simply hung on racks and air from an electric fan blown through it, in other cases the air is first driven through steam coils and escaping steam may be used to give the required degree of moisture. The electrostatic neutralizer now largely used on printing presses has to a large degree done away with the necessity for seasoning.

Photogravures or Intaglio Process. It is in the combination of volatile ink and direct fire heat drying that the hazard of the intaglio process lies. Photogravure ink and thinner have been tested which had a flash point lower than twelve degrees Fahrenheit. The quantity on hand should be the minimum possible for the daily run of the press and should be stored as indicated below under "Volatile Oils". It is evident that neither gas heated rolls nor any other fire heat in the immediate vicinity of the press should be permitted. Heat, if required, should be steam, hot air or hot water from a remote source, and no open lights nor fires should be permitted where inks or thinner are stored.

Binding. The principal hazards are the use of gas stoves and glue pots, very generally mounted on wooden tables, with flexible tube connections, and having insufficient clearance to wood cases, stacks of paper and cardboard; also it is not uncommon to find cardboard glue shields attached to these appliances and covered with an accumulation of glue.

Gas stoves should be mounted as elsewhere described. Glue pots are often set with insufficient clearance and no protection to woodwork and no carbon guards under the gas burners. Glue pots should always be guarded by metal casings, constructed double where passing through benches and providing ample clearance to combustible material. The air intake, lighting holes and pipe connections through the casing should be at least one inch above the bottom of casing, which should have no openings. Steam-heated glue pots are much safer and should be used where steam is available. Electrically heated glue pots consist of water jacket through which the resistance coils are run, and these are safer than the gas-heated pots. Steam, electrically or gas-heated embossing machines are largely used and are safe, provided care is exercised to prevent the placing of cardboard or paper on the heads of the machines. Case making and heading and stripping machines have glue pots attached usually gas-heated, the burners being underneath, and if provided with carbon pans, are reasonably safe. Appliances for bending or rubbing the

back of book covers, where gas-heated, should be constructed entirely of metal, and mounted similar to gas stoves. Leather paring or sanding machines are used on leather book covers, and metal receptacles are often attached directly to machines to receive the shavings and dust; in the larger plants a blower system is usually employed discharging to metal or other suitable receptacle. The hazard is slight.

Storage. All stock, whether it be raw paper for the printer, the lithographed or printed sheets, the book sheets, the book folios gathered and bundled for the printer, or the publishers' open case stock of books, should be skidded six inches above the floor. An important feature of this storage, especially in buildings of ordinary construction, is the tendency to pile the stock high, without sufficient passageways, and heavily loading, if not overloading the floors. This is often due to a lack of appreciation of the relatively great weight of the paper piled in a solid mass.

GENERAL HAZARDS.

Cleanliness is a very important feature in printing plants. The free use of oil, ink and benzine makes it a wise precaution to cover combustible floors under presses with metal; where this is not done, the floors soon become saturated to such an extent that their inflammability is materially increased.

Waste and Rags. Self-closing waste cans should be conveniently placed to care for all oily waste material, including rags saturated with benzine. Extreme care should be exercised to see that oily rags are not left in out-of-the-way places, or behind steam pipes or radiators. Waste should not be allowed to remain in cans over night, but should be burned every evening.

Care of Paper Refuse. All loose paper, cuttings, rubbish and useless materials should be kept in substantially constructed metal cans with covers, and promptly removed from the premises. In large plants it is customary to have a baling press on the individual floors, or a fireproof paper shaft provided, having openings to the various floors, protected by fire doors and discharging to a fire-proof enclosed baling room, also cut off by firedoors. For small paper scrap from cutters, a blower system is sometimes provided.

Metal Lockers. Substantially constructed and properly ventilated metal lockers for employees' oily clothing should be a requirement of every up-to-date printing establishment. The old wooden closets, lockers and enclosures afford a splendid opportunity for the spread of fire from spontaneous combustion of the oily clothing, and their use should not be tolerated.

Smoking. Should be absolutely prohibited. Conspicuous signs bearing the words "NO SMOKING" should be posted.

Volatile Oils. Benzine and other volatile oils should be contained in approved safety cans specially designed for the purpose. The main supply of such material should be buried in underground storage tanks,

or isolated so as not to afford an exposure to the plant. The greatest care should be exercised to limit the amount on floors to that actually necessary for the day's supply. A central filling station in charge of a competent person should be provided, and all cans stored at night in a safe place. A desirable feature in this connection is to provide a pump house of fireproof construction, detached or properly cut off from the plant where all filling is done and cans returned for storage over night. Volatile liquids are dangerous, regardless of the manner in which they are used, and by no means should they be permitted in open pans, pails, or other open receptacles. Special care should be taken to see that there are no open fires nor lights in proximity to the cleaning process.

Substitutes for Volatile Oils. There are many non-volatile substitutes for benzine and other volatile oils, and their use is to be encouraged wherever it is possible to eliminate the dangerous volatile liquids. An acceptable substitute is one which shows an open cup flash point of over 100 degrees Fahrenheit.

Chemicals should be stored in limited amounts and kept in a substantially constructed metal cabinet with ventilation to the outside air, or some other form of construction equally good.

Fire Protection. Firepails of water and sand, and chemical fire extinguishers should be distributed in ample supply throughout the premises.

Watchman ringing hourly rounds on an approved watchman's clock should be employed when the premises are not in operation.

Automatic Sprinklers. All up-to-date plants should be protected by automatic sprinklers having standard water supplies.

Department of Fire Record.

Fires in Which There Was Loss of Life.

These fires are intended to point out conditions under which loss of life occurs, that they may be known and guarded against.

Holocausts which are adequately reported in the daily press or are the subject of special investigation may not be given herein; nor is any complete record of loss of life in fires at present obtainable.

H-11539. Blower Works. Building consisted of a frame one and two-story structure with small attic and basement under the office portion; area 4,700 square feet. Roof was one-inch matched boards on ordinary joists, composition finish; floors were single ⅞ inch matched boards, ordinary joists, steel girders, wood columns. Building was occupied by a blower and copper smithing company employing twelve to fifteen people and manufacturing blowers, ventilators and carrying on heavy sheet metal work of all kinds. Basement was used for miscellaneous storage including automobile tires, rims and wheels, carbide in 100-pound cans, one barrel of lubricating oil, one automatic natural gas water heater and one second-hand Monarch fifty-pound acetylene machine of the double generator welding type. The first floor was used for an office and sheet metal shop with gas engine, charcoal forge, acetylene welding and cutting tools and machinery; second floor was occupied as a one-family dwelling and light sheet metal shop; third floor, sleeping rooms. The building was without any fire protection.

The explosion occurred without warning at approximately 1.50 P. M. To witnesses from a distance the building appeared to rise up and fall back into burning wreckage. Simultaneously windows were shattered in all buildings in the vicinity. The main force of the explosion was apparently up and out from the front end of the basement, which was located under the southeast corner of the building. Splinters and sections of siding and roof boards were scattered within a radius of 250 feet from the building. That portion of the structure directly over the cellar was completely destroyed, the balance of the building collapsing and burning. One dwelling located twenty-nine feet north of the plant was completely destroyed by fire, while the roof on the next one beyond was burned off. Two employees, a stenographer working in the office directly over the cellar, and one of the men employed in the building, were instantly killed. Another woman living in the apartment above the factory was blown through the roof and fatally injured. Many of the other employees, who numbered about sixteen at the time, received minor injuries. Windows

were broken within a radius of nearly 1,200 feet from the plant, those close at hand being blown in while those farther away were forced out. Practically all the windows and numerous skylights and inside glass partitions were broken in a one-story brick mirror factory located approximately seventy-five feet north of the plant, in addition to considerable damage done to mirror stock in the factory. The first alarm was sent in from a supervised watchman's station and fire alarm box in the mirror factory, being received at 1.53 P. M. A second alarm was sent in over a private telephone line by the acting battalion chief first arriving at the fire. A total of eight engines with eleven hose lines worked on the fire. Five of the lines in use were over 800 feet long, two 1,300 feet long. Water supply was fair. The verdict of the inquest into the explosion was that there was not sufficient evidence produced to show criminal negligence.

All obtainable evidence points to the ignition of an explosive mixture of gas and air in the basement of the plant. There are three manifestly possible sources of gas in this case. The first to be considered is natural gas from an automatic water heater located in the basement. This heater had a capacity of approximately fifty gallons of water. The gas control was by means of a thermostatic valve depending on the temperature of the water for its action and on a constantly burning pilot light for ignition. Reliable authorities advise that the maximum gas consumption of this type and size of heater would vary between 80 and 100 cubic feet per hour at the average local pressure of five ounces. Assuming the remotely possible extinguishing of the pilot light by the sucking action of a natural gas engine which was supplied from the same service pipe as the heater, gas would have to flow for a period of an hour and a half or two hours at the least before the minimum explosive limit (five per cent) of natural gas could be reached, the cubical contents of the basement being approximately 3,100 cubic feet, regardless of space taken up by generators and gasometer, water heater, vegetables, barrels, storage, etc. The significant fact remains, however, that the cellar was visited shortly after eleven o'clock on the morning of the explosion, and that employees around the office and shop, up to the time of the explosion, smelled no gas whatever and noted no unusual conditions. The second possibility is the formation of acetylene by the action of dampness or water on carbide from a damaged drum and its ignition by the flame in the water heater. After the fire nine drums of carbide were found, each of the size designed to hold approximately 100 pounds. The nine drums were each practically full, although the top of each drum was somewhat uniformly crushed either by the collapse of the debris or by extremely high atmospheric pressure at the moment of the explosion. Some acetylene was generated during the fire by the action of fire streams on carbide in the damaged cans, considerable difficulty being experienced in extinguishing the burning gas. There were also numerous empty carbide drums noted after the fire, most of these probably having come from the basement. The full cans were stored prior to the explosion on a board

approximately one inch high over a cement floor which was well drained and under usual conditions dry. It is difficult to conceive of an accumulation of sufficient gas from this source to form the minimum explosive mixture (three per cent) in the time elapsed between eleven o'clock, when the cellar was last visited, and the time of the explosion, 1.50 P. M., as the dissociation of approximately eighteen pounds of carbide would be required.

The escape of sufficient acetylene gas from the generator, gasometer or piping to form the required mixture is the last of the three possible sources, and apparently the most probable. The condition of the debris after the explosion and fire prevented any accurate determination of the condition of the generator and piping prior to the explosion, but from the fact that a large amount of sludge was found after the fire in the active generator, and that the gas had been used for only a comparatively short time by one welder since being recharged at 7.30 A. M. on the morning of the disaster, it is reasonable to assume that a large part of the entire charge of carbide had been used. Evidence brought out at the inquest showed that the active generator was fully charged that morning, after it was noted that the gas supply in the system was exhausted; that the carbide hopper of the inactive generator, the intake pipe from which had supposedly been plugged for several weeks, had been removed from the machine and taken up to the second floor of the building at eleven o'clock on the day of the explosion to be cleaned and was replaced shortly afterwards. The reason given for this cleaning was that the employee doing it had nothing else to do at the time. The contracted condition of the gasometer and generators testifies to extremely high local atmospheric pressures outside of the machine, and the effect of the explosion upon the concrete foundation walls locates the center of the explosion at the apparent point of ignition, the water heater. Comparatively well enclosed and probably poorly ventilated, the formation of a gas pocket in the basement through a leaky generator or pipe connection and its ignition by the pilot light on the water heater seem to offer the most acceptable theory for the explosion. Coupling with these facts the unfavorable location of the entire acetylene plant, the unsatisfactory explanation of the necessity for cleaning an apparently unused part of the machine on the morning of the explosion, the comparatively large amount of gas generated and the correspondingly small amount used by the one welder working during the morning, and taking into consideration the extreme violence of the explosion, the broad conclusion is easily reached that acetylene either from damaged carbide drums or from a leaky or improperly tended generator was responsible for the explosion.

The generator was a second-hand Monarch machine of the carbide-into-water type, in which the feeding of the carbide and the gas generation is regulated automatically by the position of a gas bell in the gasometer. The machine had been installed subsequent to the last inspection of the plant. The capacity of the machine was fifty pounds of carbide in each generator, producing about 250 cubic feet of gas on each generator charge.

The machine had two generating chambers, one of which it was claimed had not been in use for several weeks, the vent pipe to the gasometer being closed with an iron plug. A considerable amount of carbide sludge was found in the water tank of the unused generator after the explosion, the carbide hopper, however, being lost. The carbide hopper of the active generator was found to contain a large amount of sludge, due possibly to the action of the fire streams on what carbide was left in it. The active generator was recharged with approximately fifty pounds of carbide on the morning of the explosion at about 7.30 A. M., and employees advised that very little welding was done between the time it was charged and the explosion. It is thus reasonable to assume that nearly a full charge of carbide was in the hopper, unless a leak in the system caused automatic feeding of the carbide and consequent gas generation. The generators and gasometer were set in a small pit at one end of the basement, sludge being deposited in the pit and removed in pails to an open sewer connection in the basement, when necessary. After the explosion and fire the gasometer and generators covered with debris and damaged to some extent by the collapse of the building were in such condition that it was practically impossible to determine the condition of generator and pipe connections before the explosion took place. On examining the generators and gasometer after the fire, the gasometer bell top was found to have been torn off, crumpled up and forced down into the bell. The sides of the gasometer were crushed in and the purifier walls contracted, apparently by the difference in atomospheric pressure between the inside of the machine and the balance of the cellar at the time of the explosion. The water heater which stood about ten feet from the generator was upset and all pipe connections broken; the tank itself was not materially damaged by the prevailing high pressures at the time on account of the presence of water in it. The east foundation wall of from ten-inch to twelve-inch concrete was broken off and sections blown into the street.

Two women and one man lost their lives. Five or six other employees sustained minor injuries. Total loss estimated at $50,000.

S-19180. Rubber Cloth Works. This fire occurred in a two-story and basement, steel frame building with walls of concrete block, joisted floors and shut-off floor openings. Sprinkler equipment consisted of ordinary degree Rockwood "D" heads installed under 1905 pipe standard. It was a wet system and the heads were in good condition. Static pressure on sprinklers that operated was sixty pounds.

Fire was probably caused by employee using a heavy metal can containing naphtha which he struck on the rim of a metal rubber cement churn, causing a spark which ignited the naphtha fumes and resulted in a quick fire. The two men working in this department at the time were fatally burned. There were seven rubber cement mixers in the basement of the building and large quantitites of naphtha were used in the process. Fire was confined to the contents of the churn and slightly damaged the belts and stock. Fire was fought by sprinklers, chemical

extinguishers, private hydrant and hose. It was practically extinguished by the sprinklers, and the system was restored in a short time after the fire.

The advisability of locating a hazard of this nature in small detached buildings is apparent. The loss of life was due to the sudden and quick fire which had probably fatally burned the two men before the sprinklers could operate.

S-19045. This fire took place in a copra warehouse, a one story, frame corrugated iron building, 70 x 100 feet. Flooring was two-inch plank on joists and piles over tidewater. A large stock of copra was kept in sacks which were piled closely together. Fire was probably caused by spontaneous combustion or possibly by sparks from adjoining mill which was burning refuse. Fire was fought by the city fire department which had considerable trouble in locating the center of the blaze due to the tremendous smoke given off by the burning copra. The stock was piled so closely and to such a height that the sprinklers were ineffective, and although the fire was under control within an hour, it required some twelve hours to complete its extinguishment.

The chief of the fire department was overcome by the smoke and died on his way to the hospital.

H-11693. Garbage Reduction Plant. This was a one-story reinforced concrete building in which grease was removed from the garbage by means of distillate vapor and steam in digestor tanks. There were thirty-two steel digestors or extractor tanks used for this purpose. Large quantities of gasoline were used to help free the lard and similar grease from the other materials. It is believed that the operator was careless in some manner and allowed the distillate to escape into the room, where it became ignited. The fact that both the operator and his helper were killed prevented further investigation. The force of the explosion was so great that doors and windows were blown out and portions of the brick and concrete walls of the structure were demolished.

H-11601. This fire, probably from incendiary sources, occurred in a two and three-story lodging house. It started in the stairway to the cellar and quickly cut off the upper hallway. Two people were caught in this upper hallway and were unable to escape.

The lesson to be learned from this fatality is that even in comparatively small buildings used for residential purposes there should be at least two means of exit so arranged that the cutting off of one by fire or smoke will not impair the other.

S-18863. Manufacturer of Smokeless Powder. Building was a small one-story frame and brick structure with corrugated iron roofing on joists. Sprinkler equipment was a Grinnell glass disc wet system, installed in 1915, with ordinary degree heads. Static pressure on sprinklers operating was forty pounds. The fire occurred in the final mixing building where cordite powder was manufactured, consisting of gun cotton and

nitro-glycerine. The building consists of sixteen separate rooms, fourteen by eighteen feet, cut off from each other by twelve-inch brick walls parapetted two and one-half feet and four feet wings at the sides. Each room contained one large bread mixer, with motor located outside. Each room was equipped with six automatic sprinklers on two-inch risers and one-inch open "Jumbo" head was located over each mixer and was supplied by the same two-inch riser and controlled by a hand valve. Mixer had just been charged with about 400 pounds of remix, that is, scrap powder from presses and blenders. Acetone and alcohol had been added for cutting the charge. One employee let the wood cover down over the mixer as the other man threw the belt over to start the machine. At this time the charge took fire in the form of a flash. The flames shot some fifty feet into the air after passing through door, and ignited dry leaves over fifty feet from the building.

The man at the mixer was burned to death inside the mixer room and the other man was burned so badly that he died two days later.

The flames ignited charges in mixers in six other rooms and opened forty sprinklers in all. Three hose streams were stretched by employees who fought the fire. The pressure was very low at this time as the sprinklers and hose were supplied by gravity tank only. An examination of the mixer after the fire revealed two brass screws in the charred mass. This style of screw is used on the powder packing cases and these cases are used a great many times in collecting the scrap or remix powder. In view of the tremendous hazard the action of the sprinklers should be considered satisfactory as they prevented the fire from spreading to any great distance.

The loss of life was undoubtedly due to the unusual hazard of the business.

H-11657. Country Club House. This was a small country club house with concrete basement and frame super-structure. Apparently the fire was caused by spontaneous combustion in oily rags and paints stored at the foot of the stairway in basement. Basement was unoccupied at the time of fire. The upper stairway was not cut off from the basement in any way and the flames made very rapid progress, cutting off all escape. Five people were burned to death because of the lack of proper exits.

The practice of placing a small storeroom under the stairway for the storage of hazardous materials, such as paints and oils, cannot be too strongly condemned. Unfortunately it seems to be a favorite place for the storage of such materials.

H-11671. Power House Fire. Power house was one story in height with concrete floor and was occupied for the purpose of a pumping station for supplying city water, electric station for domestic and street lighting, and for gasoline gas generator plant, the product of which was used by citizens for cooking. The gasoline gas apparatus was not separated from the rest of the plant, nor was there any means of ventilation or removal of gasoline vapor provided, if any formed inside the building. A test mantel lamp was attached to the wall about seven feet above the floor

and a few feet from the carburetor, also the boiler fronts were not a great distance away, so that any escaping gas may have become ignited from either of these sources.

On this particular evening an explosion occurred which blew almost all the walls outward, some of the brick being scattered seventy feet from the building. Fire ensued which destroyed the debris. The engineer was found dead among the brick just outside the walls, and since he was the only person inside the building there was no way of obtaining accurate knowledge of what happened. It was believed by those familiar with the working of the plant that a valve had been left open which allowed the gasoline to flow over the concrete floor, and this became ignited when the engineer lighted the test lamp in the room. There are several items which would substantiate this opinion.

This seems to be a clear case where the hazards of the business were absolutely ignored by those in charge.

H-10791. Rooming House. Ten men were killed and six others seriously burned due to an explosion and fire which occurred in this frame rooming house about 12.30 A. M. There were sixteen men sleeping at the time in the house which had five rooms, two down stairs and three on the second floor. Four of the men slept down stairs and the others occupied the second story rooms. A gas stove with a rubber hose connection was burning in a room on the first floor and it seems quite certain that the hose was either burned off or became disconnected, allowing the gas to escape into the rooms. The house was soon filled with gas and when it reached upstairs where two oil lamps were burning, a terrific explosion occurred and the whole house was almost instantly enveloped in flames.

The lesson is obvious.

H-11285. Girls' School. This fire occurred in a three to six story ordinary frame building occupying a small triangular block about 110 x 200 x 240 feet. It was located on the side of a hill so that one side was three stories above grade and the other side about six. Building had no fire-fighting apparatus and no fire escapes. The cause of the fire is unknown but it apparently started on one of the upper floors and was beyond control when the fire department arrived. Five girls lost their lives.

All buildings used for such purposes should have serious consideration given to the fire protection feature as well as fire drills, etc.

H-11427. Rooming House. A woman was cleaning a shirtwaist in one of the front rooms on the first floor with gasoline, having one gallon in an open dish. The maid was in the cellar stoking the furnace fire and had the door open. It seems probable that the gasoline vapors found their way down to the furnace door where they were ignited, or it is possible that the gasoline was ignited by static electricity caused by rubbing the waist. A severe explosion and fire followed, which burned four people to death and seriously injured three others. Four additional people received minor burns.

H-11538. A vacant room in this building was being used by the public school officials for an art exhibit, and inasmuch as the exhibit was to extend into the night when it became quite cool, arrangements were made for furnishing heat. The city secretary ordered the gas connected to a stove of the radiator type which was in the building, and also to a hot plate stove. These connections were made by inexperienced plumbers who, it seems, were ignorant of the arrangement of the gas pipes underneath the floor. The gas had not been in these pipes for some time as it had been turned off at the main when the previous occupant moved out. This last occupant took the stove with him, also the riser connected thereto, thus leaving an open orifice one-half inch in diameter under the floor, through which the gas escaped when it was again turned into the service pipes. The gas was turned on about 4.30 P. M. and when the superintendent of public schools entered the room at 7.30 P. M. with his wife and other ladies and children, someone remarked that the odor of gas was very perceptible. The testimony of two witnesses present at the time is to the effect that the superintendent believing the gas to be escaping from the rubber hose connection to one of the stoves, struck a match to see if he could locate the leak. When he applied the match to the hose, a blue flame immediately shot up from a small hole in the floor. He placed his foot over this hole, probably with the idea of stamping out the flame, but immediately an explosion took place which resulted in the death of himself, his wife and seven other persons, several of whom were killed in an adjoining restaurant which was crushed in by falling walls.

H-11425. Apartment House. Fire started in the basement at the bottom of a chute of wooden construction which passed up through the different floors. This chute was used by the tenants for the disposal of waste matter which was dropped to the floor of the basement. Fire was seen through a window by a passerby who gave the alarm. It spread so rapidly that the main stairway was cut off by smoke and heat, and although a tower stairway at the front was available, the panic stricken inmates ran to the windows where some were rescued and others jumped to the street. Three lives were lost as a result of the fire.

Explosion and Fire at Factory of Chandler Oil Cloth Co., Yardville, N. J., May 2, 1916.

By A. R. Ramsdell (Member N. F. P. A.)
Engineer, The Schedule Rating Office, Newark, N. J.

An explosion and fire under what seem to have been ideal conditions for disaster occurred at the Chandler Oil Cloth Company's plant, Yardville, N. J. (about four miles from Trenton, N. J.) about 4.30 P. M. on May 2, 1916, and resulted in the death of six men, injury to several others, and the complete destruction of about 40 per cent of the building. As far as can be learned from fire records and the various inspection

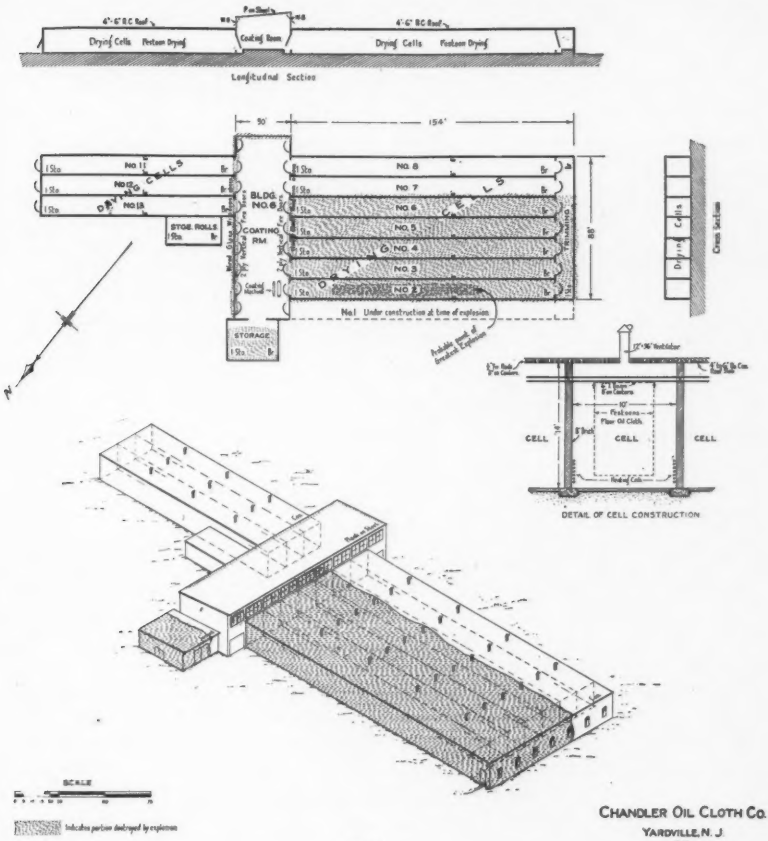

FIG. 1

bureaus there have been numbers of flash fires in drying cells and coating rooms in oil cloth factories caused by the ignition of gasoline vapors, but never an explosion of this nature.

The loss by fire was slight, the oil cloth in one cell being consumed and the coating machine damaged.

Construction.

By referring to the plan and isometric drawing as shown in Figure 1 a good idea can be had of the building which was practically new and intended to be an improvement over the usual construction of this class of factory. The coating building was of brick and steel construction, one high story in height, roof of 1½-inch plank on steel beams, and was cut off from the drying cells by 2 ply tin-covered vertical sliding fire doors.

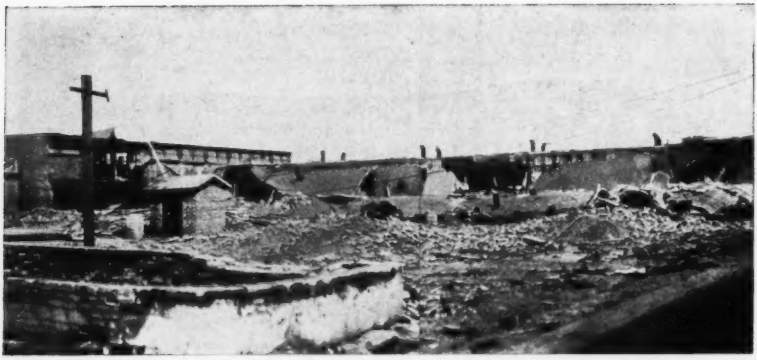

Fig. 2

The drying cells were of fire resistive construction, 8-inch brick walls with reinforced concrete roof varying in thickness from 4 to 6-inches. Reinforcing rods ½-inch diameter (twisted) were located very close to the lower side and placed about 8-inch on centers. The cells were braced near the top by 6-inch steel I beams about 8-foot centers, which also acted as a hanger for the festoons, etc. The openings into the trimming room were protected by two ply tin-covered automatic fire doors and above each of these doors there was an opening about 1 foot wide and 7 foot long through which the goods passed. These slots were protected by a tin covered swinging cover hinged to the wood frames of the openings.

Floors of each cell were of brick, covered with cement, and except for the fire doors at each end these cells had no other openings in the walls. The roof was provided with four ventilators 12 inches in diameter and 36 inches high with cone-shaped tops and vanes. These ventilators were too small and feeble to produce an effective draught, or a vent in case of an explosion.

Criticism could be made of the construction of the drying cells on account of the thin brick walls 14 feet high and 8 inches thick with no pilasters carrying the reinforced concrete roof 4 inches to 6 inches thick, 10 feet wide slab with poor reinforcement.

Examination of the brick work showed a poor quality of workmanship, joints being entirely too large, and the cement mortar too lean, the bricks laying in piles instead of holding together. The concrete roof, apparently of gravel concrete, was too heavy and reinforcing rods too close to the ceiling as can be seen by referring to Figure 7.

Occupancy.

This concern manufactures an imitation hard-wood-floor oil cloth; carriage and automobile oil cloth made from burlap, cotton cloth and canvas duck. The floor oil cloth is the chief product and was the particular stock going into the cells on the day of the explosion. The burlap

Fig. 3

usually comes with one coat of sizing and is put onto the coating machine where it receives a heavy coat of a mixture composed of dry color, boiled linseed oil and gasoline, after which it is carried in the shape of festoons by a sprocket conveyor into the drying cell. This process is usually repeated until four coats have been built up on the surface of the burlap, after which it is ready to be printed and dryed as before.

The coating material is mixed in another building and is brought into coating room in wooden tubs holding about 20 gallons each. Usually four or five tubs are in this building and as they are used on the coating machine some gasoline is put into the mixture to make it of the right consistency to coat well.

Each drying cell will hold about 1,500 running yards of 74 inch goods and each coat requires approximately nine to ten tubs of coating. It is estimated that 25 to 30 per cent of the mixture was gasoline or 45 to 50 gallons when the cell was full. (The word gasoline is understood to include benzine or naphtha since these names designate distillates of petroleum or crude oil varying only in their density.)

The knife, rolls and frame of the coating machine were grounded to a steam pipe and the steel work in the cells connected by wires in places. As far as could be seen after the explosion these grounds were apparently of little value for carrying off static electricity.

Fig. 4

The drying cells were lighted by electric incandescent lamps which were in vapor-proof globes protected by wire guards. Wiring was in metal conduit. This system had never been inspected by the underwriters having jurisdiction and there is some doubt as to its having been standard. The lighting system in the coating room was open wiring and incandescent lights apparently standard. The sprocket conveyor in the drying cells for carrying the festoons of oil cloth was belt-driven, receiving power from an underground shaft from a detached building.

Heat for the drying cells is supplied by steam coils on the sides and is applied shortly after each cell is entirely filled. It is usually the custom to fill the cells during the day and to apply the heat during the night removing the oil cloth in the morning. The amount of heat varies from 125 degrees F. to 175 degrees F.

Protection.

The inside protection of these buildings consisted of a supply of pails and chemical extinguishers. Automatic sprinklers were under consideration by the assured but would have been of doubtful value with the conditions existing at the time of the fire.

The outside protection consisted of a yard hydrant system of three two-way wood hydrants on 4-inch underground piping supplied by two 10,000 gallon gravity tanks giving twenty-five pounds pressure and from

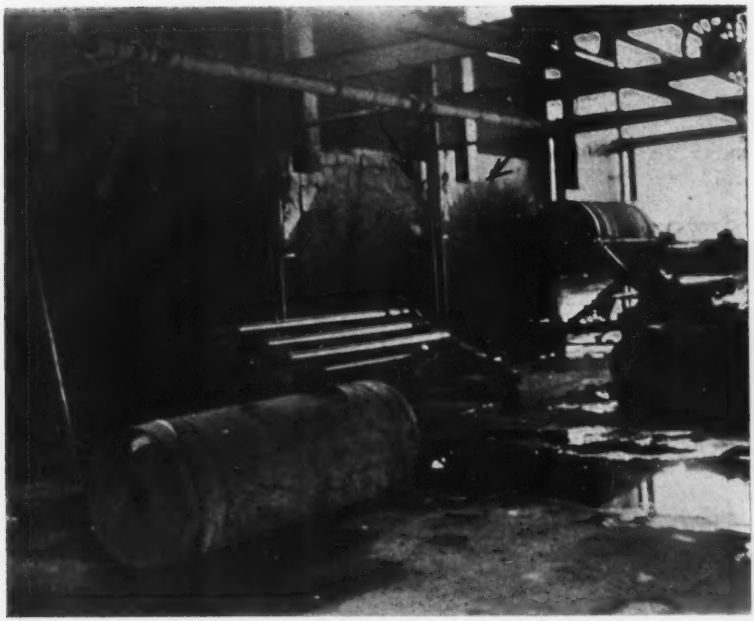

Fig. 5

a Miller Duplex Pump 6-inch x 4-inch x 8-inch with suction supply from a 30,000 gallon reservoir. There was no public protection in the town.

The Explosion and Fire.

It seems that the explosion occurred about 4.30 P. M. when cell No. 2 was almost filled, all the other cells having been filled and doors on each end closed. From what can be learned from some of the victims before they died, a slight blueness in the air followed instantly by one tremendous explosion was their only remembrance of the event. As can be seen by referring to Figure 3 the seat of the explosion seems to have been about in the center of cell No. 2. Cell No. 1 was under construction; only the walls and steel I beams were in place. Four of the victims were in this open cell and were killed by the falling walls and roof of cell No. 2. Figure 8 shows this cell a few days before the explosion. The explosion completely wrecked cells No. 2, 3, 4, 5 and 6 and passed into the coating room through the ends of cell No. 2 and 3 as the fire doors on these cells were blown towards the coating room. Fire door on cell No. 2 was blown upwards and was caught on the steel frame work as shown in Figure 4; the door on cell No. 3 was torn off at floor level and blown across the coating room into the yard. By referring to Figures 3 and 4 the destruction at the openings from cells No. 2 and 3 can be seen. The heavy coating

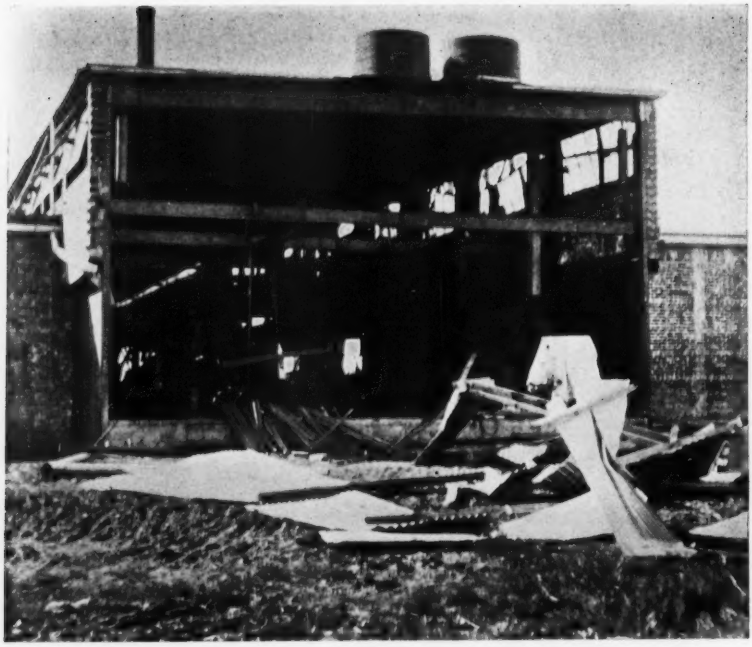

Fig. 6

machine was turned around about 30 degrees and the two men who were operating it were fatally burned. Fire doors in cells No. 4, 5, 6, 11, 12 and 13 were wrenched from the channel irons and bent inwards as can be seen by referring to Figures 4 and 5 while the fire doors at the extreme ends were blown outward and some of them badly damaged. The small storage building on the north end was practically demolished while on the south end the light iron wall of the coating room was blown out as shown in Figure 6. The roof of the coating room was lifted several inches from the steel frame and the wired glass windows mostly broken or demolished.

The extent of fire was small, being confined mostly to cell No. 1 and extending to the coating machine. Immediately after the explosion the mill fire brigade succeeded in extinguishing the fire with hose streams.

Probable Causes.

It is estimated that in the drying cell being filled, there were at least 30 to 40 gallons of gasoline in the mixture on the oil cloth which was in festoons and would make a good mixture with the air when in this form. The gasoline used was 60 degrees to 62 degrees Beaumé. At ordinary temperature the air would carry about 5 per cent of this gasoline vapor.

Fig. 7

Fig. 8

The limits of explosibility of mixtures of gasoline vapor and air are between 1.4 to 6 per cent which is narrow compared with flashes of flame obtained in mixtures in considerable smaller and larger proportions of vapor. One gallon of gasoline can under ideal conditions render 2,100 cubic feet of air explosive but such a condition is seldom found and there is at present no way of knowing the danger condition. In oil cloth factories the practical way of telling of impending danger is by the feeling of the workman in what is known as a "gasoline drunk". The U. S. Department of the Interior Bureau of Mines has developed a

small, handy portable gas detector which will be ready soon for public use, but little is as yet known about it.

There is little doubt that this explosion was caused by the ignition of gasoline vapor. Just how a spark or flame appeared at the particular time where the mixture of gasoline vapor and air was best can only be surmised.

It is well known that static electricity has been the cause of trouble in most all occupancies of this nature and the usual method of safeguarding this hazard is adequate; grounding or by use of steam jets or wetting the floor. In this particular case the method of grounding was probably of little use and from a practical point it would seem that no absolute dependence can be placed on any system of grounding alone. Static electricity can be formed by the coating knife, the rolls on the coating machine, belting and shafting and the sprocket wheel and chain on the festoon conveyor.

The use of waste burlap sometimes saturated with paint or gasoline and used as a "leader" might ignite spontaneously as could oily waste which might have been swept into the drying cell.

Conclusion.

To prevent as far as possible the repetition of explosions and fires in drying cells and coating rooms of oil cloth factories, the following recommendations seem in order:

1. Where drying is accomplished by direct radiation in the drying cells, as in this case, a system of ventilation by means of an exhaust fan located in a separate building, taking suction from the bottom of each cell, and discharging to the atmosphere should be provided. While the oil cloth is being put into the cell and for at least one hour after the cell is full, the fan should be run so as to remove as much of the gasoline vapor as possible before the heat is applied. The design of this system is a matter for the ventilating engineers to arrange according to the condition.

2. Drying cells of this type and occupancy which are subject to a possible explosion should be built of brick or concrete walls at least 12 inches thick and a roof of light fire resistive material such as asbestic-slate or its equivalent supported on steel work. Powerful ventilators should also be provided. Approved 3-ply tin covered fire doors should be provided at each end.

3. The coating machine should be provided with steam jets which should be in operation before coating is begun; jets should be located between roll and knife and between knife and delivery roll; frequent sprinkling of the floor to keep humid condition of air would also be a safeguard.

4. The coating machine knife, rolls, etc., shafting and machines on which belts are run, the sprocket conveyor and steel work for them

should be grounded as perfectly as possible and frequent tests should be made.

5. Electric light wiring in coating room should be standard, arranged in conduit, all light in vapor-proof globes with wire guards. It is suggested that light from wired glass skylights in the cells would be preferable to electric lighting.

6. An approved system of automatic sprinklers should be provided throughout the drying cells and coating room arranged to meet the approval of the inspection department having jurisdiction.

7. The quantity of coating-mixture and gasoline stored in the coating room should be reduced to a minimum.

Elevator Fire and Explosion
Canton, Baltimore, Md., June 13, 1916.

By Pennsylvania Railroad Company—Insurance Department

(Member N. F. P. A.)

On June 13, 1916 fire followed by explosion destroyed the following properties at Canton, Baltimore, Md. — Grain elevator No. 3, wharf, grain dryer, marine tower, upper and lower belt conveyor galleries connecting grain elevator with concrete storage tanks, power plant, carpenter shop, men's building, office building, all machinery and contents of these buildings exclusive of grain in elevator, and eight freight cars on track floor of elevator. The grain from elevator will be salved for the best interests of all concerned. The trestle approach to elevator and the ore pier for No. 3 yard were damaged. The steamers Wilhelm van Driel and Welbeck Hall, tied up alongside elevator loading grain cargoes, were also badly damaged.

The work of salving the grain will proceed at the earliest opportunity as soon as ruins have sufficiently cooled, a temporary trestle approach constructed and bids accepted for the work. It is believed the amount of salvage on grain will be necessarily low due to collapse of elevator bins thereby allowing mixing of various kinds of grain, the presence of salt water at this point, and the gradual deterioration of the grain submerged under water, together with consequent heating of the large bulk of grain being wet down by fire streams for the purpose of cooling ruins.

This disaster resulted in serious loss of life and personal injuries. The total deaths to June 17, 1916 were seven (five missing being included in this number) and the total number of injured, twenty-two, thirteen of whom are still confined to various hospitals in Baltimore. Of the dead, four were employes of the Central Elevator Company, two of the Chamber of Commerce and one a stevedore on the Wilhelm van Driel. Of the injured, twenty-one were employes of the Central Elevator Company and one of the Chamber of Commerce. It is exceedingly fortunate from the standpoint of life that the disaster occurred in daytime thereby allowing a number of the employes to escape. The loss of life, had the disaster occurred at night, would undoubtedly have been enormous as the extin-

guishment of the electric lights by the explosion would have prevented escape.

Cause.

A careful investigation to determine the cause has been made and the testimony taken of officials and employes of the Central Elevator Company, conclusively establishes the fire to have been due to sparks or heat from friction igniting grain dust in suspension which was followed by a violent explosion. The detail events causing the disaster were the choking of one of the elevating belt-bucket conveyors preventing moving of the belt, the resultant friction of revolving head pulley against the stationary belt causing it to burn through; the temperature and sparks produced from the friction ignited interior of wooden housing enclosing conveyor, the descent of the belt and buckets disturbing accumulations of grain dust in interior of wooden housing, the wrecking of a portion of housing by the falling conveyor, the ignition of grain dust in suspension in interior of conveyor-housing by sparks from the smouldering fire caused by the friction — this was followed by a violent explosion. The primary cause was a misunderstanding through a speaking tube conversation of the particular elevating conveyor which was out of order, — elevating conveyor No. 2 was first reported choked but investigation determined that conveyor No. 3 was choked and inoperative, the employe receiving the message having misunderstood the number of the conveyor reported out of order. The necessary delay occasioned by this error allowed sufficient time to elapse for the burning through of conveyor belt in No. 3 by revolving head pulley before clutch disengaging power at this point was operated.

In most instances of explosions of grain dust in elevators, there are usually two separate explosions involved, the first being slight and caused by ignition of fine grain dust in suspension in immediate vicinity of sparks or temperature causing the ignition, the concussion produced by this explosion disturbing and dislodging dust that is settled and packed on surrounding ledges and projections, which shaken into suspension makes an additional explosive mixture which becomes ignited by the heat or flame from the first explosion, resulting in the second explosion which propagates throughout a very large area until the entire dust zone is covered. The testimony taken in the examination of employes does not definitely determine the occurrence of two explosions; it is believed, however, that the noise of the first or small explosion was muffled by falling of the bucket-conveyor, which, in its descent wrecking a portion of the housing around same, created sufficient openings for the concussion of the first explosion to disturb quantities of grain dust within a large area.

The investigation as to the cause of the disaster covered all common and special hazards liable to be productive of fire such as smoking, hot journals, static electricity from machinery, spontaneous ignition of oily waste, sparks from boats lying alongside, sparks from locomotive, electric light wiring, heating arrangements, presence of foreign material in grain being elevated, temperature of elevator, incendiarism, malicious intent

by war sympathizers, dissatisfaction among employes and labor troubles, but it was found that none of these hazards could have contributed in any way to the fire.

Narrative.

Shortly after 2.00 P. M., June 13, 1916, Adam Schmidt, one of the weighers on scale floor, now among the missing, reported to the millwright that elevating bucket-conveyor No. 2 was choked due to over-feeding of buckets, but upon investigation this conveyor was found to be operating satisfactorily and the millwright was then informed that the trouble was in No. 3 elevating bucket-conveyor (Schmidt, who received the information from speaking tube conversation, having misunderstood number of conveyor which was not operating). An examination was made of No. 3 conveyor which showed belt conveyor to be at a standstill and before the clutch disengaging the power from the head pulley could be operated, belt had burned through from friction of revolving head pulley and parted — this was in the neighborhood of 2.15 P. M. When belt parted and fell, carrying with it the bucket conveyor, a considerable portion of housing surrounding No. 3 conveyor was wrecked, allowing several openings through which belt and conveyor buckets protruded.

An examination of the interior of conveyor housing was made by the millwright who had detected a peculiar odor indicating burning of canvas, presumably the belt, but he was unable to discover any evidence of fire. Upon examination of the belt at track floor it was found that it had not parted at the splice, but at another point due to burning of belt from friction of revolving head pulley. This belt was installed June 20, 1915, was twenty-two inches wide and eight ply, and had been inspected within a week — the life of these belts varies from thirteen to fourteen years and one belt of the six contained in the elevator was inspected every day. Before the millwright could obtain necessary tools from carpenter shop, for purpose of repairing belt, a terrific explosion took place about 2.30 P. M., as near as can be determined.

About 2.25 P. M. elevator foreman detected odor of smoke on track floor of elevator while working at elevating bucket-conveyor No. 2 and upon lifting trap of No. 2 hopper feeding this conveyor, discovered a strong gust of hot air, whereupon he threw a bucket of water down hopper and slammed trap door down and in less than a minute from the time he had opened trap heard a loud rumbling sound which was the explosion taking place on the upper floors of the elevator. He immediately attempted to escape and on his way out pushed button on electrical fire alarm system from one of the stations on track floor — before he could escape from the building, the explosion occurred. The receiving hoppers at track floor are not flush with underside of flooring, allowing communication whereby hot gusts of air from explosion communicated from hopper of No. 3 elevating conveyor to hopper of No. 2 elevating conveyor.

The hopper boss on track floor of elevator discovered smoke about 2.25 P. M. at the same time elevator foreman had detected odor of smoke.

About the same time one of the laborers on track floor was told that a spark of fire had fallen down No. 3 elevating conveyor. He attempted to get a bucket of water to pour into hopper but before accomplishing same the explosion occurred.

Also four employees on scale floor, two of whom are now dead, discovered fire on machinery floor above; one of these men pushed button on electrical fire alarm system from one of the stations on scale floor and another taking a chemical extinguisher attempted to go to machinery floor to extinguish fire. As near as can be determined these events took place about 2.25 P. M. When about half way to machinery floor, employee with chemical extinguisher discovered from reflection on stairway landing that entire machinery floor appeared to be on fire and before he could return to scale floor the explosion took place.

Just before the explosion occurred probably about 2.29 P. M. gong and indicator in engine room of tower plant registered (from alarm turned in either by foreman on track floor or employee on scale floor) and "Gulland" valve controlling water supply to interior standpipe system operated, but as the explosion followed the fire with such rapidity none of the fire extinguishing apparatus in elevator could be brought into service. Upon receipt of alarm in engine room, plant whistle was tied down to summon aid from locomotives equipped with fire extinguishing apparatus in vicinity and agent's office at Canton Piers was telephoned to summon city and county fire departments from alarm boxes at that point.

Several locomotives equipped with fire extinguishing apparatus arrived promptly, two county land fire departments and city fireboat "Deluge" are said to have arrived approximately one-half hour later. As the explosion completely wrecked elevator and the flames from the fire were spreading to adjacent buildings on pier, locomotives confined their efforts to removal of a number of freight cars from the danger zone. The fire spread from elevator to grain dryer, thence through upper and lower belt-conveyor galleries to marine tower and superstructure over concrete storage tanks; also from elevator to power plant thence to carpenter shop, men's building and office building — all of these structures were located on pier directly north of elevator. Falling walls and burning debris from elevator as it collapsed from the explosion fell into boats tied up on either side of elevator. The intense heat from the burning woodwork of elevator set fire to the ore pier for No. 3 yard on the west; the damage however, to this pier was slight owing to the good work of the fireboat, which also rendered good service in preventing the spread of the fire from the upper conveyor gallery to the superstructure over the concrete tanks until the steel members supporting this conveyor gallery buckled from the intense heat from elevator fire and collapsed.

It would appear that the fire originated in the neighborhood of 2.15 P. M., the woodwork having smouldered from the temperature developed by the friction until resultant flames ignited the grain dust.

Amount of Loss.

The loss to buildings, machinery and contents, including grain, is estimated at $935,000, all of which is assumed by the Pennsylvania R.R. Co.'s insurance fund; the fund, however, had reinsurance with underwriters of $647,500, which makes the net loss to the fund approximately $287,500.

Description.

The elevator was of frame construction, covered with corrugated iron, 181 feet high x 242 feet x 98 feet, having a rated capacity of 1,000,000 bushels. The first floor was brick enclosed to a height of about 25 feet, the window openings therein being protected by iron shutters — all window openings above this point were protected by ½-inch mesh wire screening. The elevating legs were frame and hoppers frame lined with metal. The elevator was carried on stone and concrete piers built upon grillage supported by wooden piles in clusters cut off at low water and consisted of track, bin, mezzanine, scale, machinery and top floors. There were two tracks for cars on ground floor. The elevator was situated at the foot of 13th Street, Canton, Patapsco River, Baltimore, Md., owned by the Northern Central Railway Company, leased by the Pennsylvania R. R. Company and operated by the Central Elevator Company. There were six elevating bucket conveyors provided, these conveyors consisting of a vertical belt with elevator buckets spaced approximately 13 inches apart, the belt extending from receiving hopper 15 feet below the track floor to within 6 feet of the top of building, running over a head pulley 84 inches in diameter enclosed in wooden casing; the buckets discharged into scale hoppers; the head pulley was driven by rope from friction clutch on line shaft situated on machinery floor; (dust-proof bearings examined four times every twenty-four hours were used) — it was in one of these conveyors, No. 3, where the fire started. A Warren Ehret roofing was provided on elevator.

The power plant consisting of brick engine and boiler rooms, communicated with elevator through engine shaft passing through division wall, opening for which was sealed with iron sheathing. Engine and boiler rooms were 24 x 26 and 24 x 16 approximately, 50 feet in height, also equipped with Warren Ehret roofing.

There was a 3-story brick grain dryer building 47 x 29, built on concrete foundations supported on piling, separated six feet from elevator but connected therewith by a belt conveyor.

There are thirty-two reinforced concrete tanks located on the mainland having a rated capacity of 1,000,000 bushels, each tank having 29,000 bushels capacity with additional storage space of 8,000 bushels for each interstice between tanks. There is a 2-story superstructure built over tanks of metal frame, terra-cotta walls and concrete floors. These tanks are located about 400 feet from elevator and 159 feet from marine tower and were connected to elevator by two belt conveyor galleries, one from bin floor of elevator to top of tanks and the other from track floor of

elevator to their base — the upper gallery was corrugated iron throughout and the lower one frame covered with corrugated iron; cement floors were provided and tile roof covered with paper. Metal partitions were provided on both sides of marine tower for draught stops in upper gallery, but as stated in previous reports these partitions did not cut off the draught through gallery owing to conveyor openings; wooden partitions were provided in lower gallery on each side of the marine tower.

The carpenter shop was corrugated iron building 18 x 36 x 16 equipped with Carey roofing and located on wharf between independent boiler stack of power plant and men's room.

The men's building was of frame construction 16 x 24 x 16 equipped with tin roof and located north of carpenter shop.

The office building was of frame construction, one story in height with 2-story addition on north end equipped with tin roof and located north of men's room, on the wharf.

Lighting.

Electricity was used for lighting throughout the elevator and other buildings. The wiring in elevator was installed in iron pipe conduit with enclosed cartridge fuses contained in wooden switchboard cabinets lined with asbestos. All lamps in elevator were provided with vapor-proof globes protected with rigid wire guards, in addition to the regular incandescent globes. Portable electric lamps with heavy reinforced wiring were used for ascertaining the amount of grain in various bins; these lamps were also provided with vapor-proof globes protected with extra heavy rigid wire guards, in addition to the regular incandescent globes. "Eveready" electric lanterns were used by night watchmen in making tours of elevator. "Federal" electric lanterns were used on track floor of elevator by trainmen for signaling purposes. Electric flash lights were used by elevator employees on track floor for obtaining car numbers.

Heating.

Steam radiators were installed in weighers' room on scale floor and shippers' room on bin floor but were not in service the day of the fire.

Watchman Service.

There were three day watchmen employed from 6.00 A. M. to 6.00 P. M. remaining on duty until relieved by night watchmen; two of these watchmen patrolled the platforms on dock outside of either side of elevator, registering hourly from stations on track floor on Eco magneto watchmen's clock, the remaining watchmen being stationed outside elevator at north or shore end to prevent entrance of all unauthorized persons.

There were three night watchmen employed from 6.00 P. M. to 6.00 A. M. remaining on duty until relieved by day watchmen; two of these watchmen made regular hourly tours of elevator registering from twenty stations on the magneto clock, the remaining watchman being stationed outside the elevator at north or shore end to prevent entrance of all unauthorized persons.

Fire Equipment.

The water supply for fire protection purposes was obtained from river through a 750-gallon "Worthington" duplex fire pump equipped with Fischer regulator set at 120 pounds, pumping into standpipe system reducing from seven inches to three inches, supplying in all twenty-eight hose connections in elevator, two in marine tower, one in power plant, one in belt conveyor gallery in grain dryer, one in upper conveyor gallery to storage tanks and three in lower conveyor to storage tanks. A 50 foot section of 2½-inch hose was attached at each hose connection with hose spanner, cotton rubber lined hose having been provided on track floor, hung over saddles and unlined linen hose on all upper floors folded on vertical hanging hose racks. The standpipe system was maintained dry throughout the year controlled by a "Gulland" valve connected with fire alarm circuit, opening automatically and supplying water to standpipe system when alarm was sounded — as noted in the narrative, this valve operated efficiently. A siamese hose connection to standpipe system was provided on side wall.

There was also a supply of approximately forty water casks and eighty-eight fire pails, together with several chemical extinguishers and eight sand pails distributed throughout elevator and marine tower, — some of these fire pails were utilized and an attempt made with one of the chemical extinguishers as noted in the narrative.

There was an electrical fire alarm system installed with push buttons distributed throughout elevator comprising twenty stations, centering on gong and indicator in engine room of power plant and sounding a ten inch gong on each floor of the elevator—as noted in the narrative this system operated efficiently.

Smoking.

Smoking was positively prohibited in all parts of the elevator or on dock outside of same, and this rule was rigidly enforced. Employees were also prohibited from carrying any smoking material into elevator in their clothes or otherwise and as additional precaution for enforcement of this rule, all elevator employees were required to change from street clothes to working clothes before entering the elevator, in men's room on wharf outside where metal lockers were provided.

Dust Collecting.

A system of floor sweeps supplied from trunk lines running the length of elevator by large suction fan was provided for dust collecting purposes and in addition, four reliable men were employed for sweeping purposes exclusively, to keep down as far as possible accumulation of dust in portions of elevator not accessible to the floor sweeps.

Operation and Maintenance.

This elevator had been operating day and night since September, 1915. The general order and cleanliness of the elevator has been found to be particularly good for this class of risk in the various inspections made

from time to time by this Department; however, owing to the operation day and night, dust accumulations throughout the elevator were greater than under normal conditions. Formerly a dust collector system was provided which kept the elevator as free of grain dust as was possible in this class of occupancy, but due to an arbitrary ruling of the Baltimore Chamber of Commerce in forcing the removal of canvas ducking from spouting bins on the claim that it interfered with securing accurate weight, the system was disconnected.

Previous Fires.

This is the third elevator at this site to be destroyed by fire, fires occuring January 13, 1890, December 31, 1902, and June 13, 1916, the first two fires being due to sparks from boats adjacent to the elevator.

Damage to Boats.

The damage sustained to the Wilhelm van Driel and the Welbeck Hall tied up alongside the elevator on the west and east docks respectively is unknown, but both caught fire and were considerably damaged including their cargoes. These vessels were not taken out into the stream until several hours after the fire had started.

Concrete Construction.

This fire forcibly illustrates the fire-resistive qualities of concrete, none of the concrete storage tanks being damaged by fire or heat.

Rebuilding.

The grain will be removed from the concrete storage tanks by special machinery to be installed at this point as soon as possible in order to facilitate export shipments and to dispose of any grain from the tanks that may have been damaged by smoke or water.

Plans have been prepared for the erection of a new concrete elevator on the mainland which will be used in connection with the present concrete storage tanks which were not damaged by the fire, and a long marine conveyor gallery will be provided for loading to boats.

Investigated June 14 and 15, 1916.

G. C. Williams,
Inspector.

P. S. — Since writing the above report, one of the Central Elevator Company's injured employees has died and the body of a stevedore recovered from water, making the total deaths to date, 9. (July 8, 1916).

Points of Interest from Fire Reports.

These notes are intended to illustrate the efficiency or inefficiency of signaling, retardant or extinguishing agencies.

Automatic Sprinklers

S-19266. Manufacture of Celluloid Novelties. A piece of material was being passed through the rounder and apparently had not been previously cut the correct size for it caused considerable friction. Sufficient heat was generated to cause the ignition of the material. A burst of flame broke out which immediately ignited the dust in the vicinity. Thirteen sprinkler heads operated so promptly and effectively that a stock of some thirty or forty pounds of celluloid nearby was not ignited. The fire was entirely extinguished by the sprinklers with a very small loss.

This illustrates the efficiency with which a properly designed sprinkler system can control this exceedingly severe hazard.

S-19221. Varnish Works. Fire started on the second floor of the building where shellac is dried in frame dryers heated by a steam coil and fan. The cause is unknown. The sprinkler system was of no value as the gravity tank in the building was empty and water supply from town reservoir gave only eight or ten pounds pressure at the yard level and no water reached the second floor. The local volunteer fire department finally extinguished the fire but only after two small adjoining buildings had been destroyed, with total loss of about $30,000.

The particularly interesting fact about this fire is that the **property owners were notified twenty-two days previously,** during an inspection, that the sprinkler system was in this condition. Apparently no steps had been taken to improve matters.

S-19249. Fire occurred in the premises of a cloak and suit company under a cutting table and extended for a distance of about twenty feet. The table was not equipped with fire stops; consequently the flames spread along to the end of the table where the end brace board acted as a curtain and banked sufficient heat to operate two sprinklers. These extinguished the fire.

S-19121. Woodworking Plant. This fire, which started in the basement, opened twenty-two sprinklers in the first story. The public fire department laid in hose streams and used cellar pipes through holes cut in the floor. Thinking they had the fire under control, the chief of the fire department ordered water shut off the sprinklers. A trap door in the floor was then opened, which action was followed by a rush of

flame up through this opening and through a belt opening in the floor nearby in the center of the mill. The flames worked up alongside a wooden post, spreading up through cracks in the floors above to the third story. Fortunately two men had been kept at the controlling valve of the sprinkler system and as soon as it was realized that the fire was not under control, the water was again turned on. Although every sprinkler in the top story opened, the actual burning was confined to a space about fifty feet square on the roof. The fire was soon under control since the sprinkler system was well supplied with water. The loss amounted to about $6,000, whereas had the sprinklers not been shut off too soon, it probably would have amounted to only a few hundred dollars.

Many of the worst losses in sprinklered properties have been caused by shutting off the water from the sprinkler system before the fire was completely under control.

S-18665. Cotton Yarn Mill. Fire occurred in this plant about 12.30 A. M. and opened twenty-one sprinklers. A second fire broke out in the same location about 1.30 P. M. on the same day, and since the sprinkler system had not been put back in commission, the second fire resulted in a considerable loss, three hose streams being used.

In the event of a fire the sprinkler system should be restored to working condition at the earliest possible moment.

S-19064. Metal Worker. The watchman on his round found water leaking through floor and on investigation found a fire in a japan oven. He immediately telephoned the superintendent who, having in mind a heavy water damage, instructed the watchman to turn off the sprinklers. The superintendent arrived soon after and found that the fire had gained considerable headway. He opened the valve controlling the sprinklers and gave a public alarm. The shutting off of the sprinklers had allowed the fire to burn through the japan oven into the room and spread throughout the ceiling. The public department used one hose stream in assisting the sprinklers to extinguish the fire. The loss was about $3,000.

The water from sprinklers should never be shut off until a careful investigation has been made to ascertain the condition of the fire.

S-18563. Sheet Metal Worker. The district chief went to the upper part of the building and upon reaching the fourth floor found it filled with dense smoke but could see no flame. He ordered a line of hose brought to this floor and upon its arrival he states that he was of the opinion that he could control the fire without the aid of the sprinklers, and he directed one of the firemen to close the sprinkler valve at the bottom of the riser. Shortly after the valve was closed the fire again started up and spread to the fifth floor through the open well-hole and was soon beyond the control of the hose line which had been brought in. After some delay the sprinkler valve was re-opened but not until a heavy loss had been sustained.

Many large losses in sprinklered properties are due to the closing of the sprinkler valve before accurate knowledge of the situation is obtained.

S-18516. Metal Worker. Fire which evidently originated around steam pipes back of some wooden shelves occurred in the early morning after the last round of the watchman. A single sprinkler operated and extinguished the fire. Since there was no alarm system the water continued to flow for about an hour. When the first employee arrived he found that the water had leaked through the floors and caused considerable damage.

This seems to be a case where a properly installed alarm valve might have saved considerable loss.

S-19247. Cotton Lace Mill. Fire started in a small closet on the first floor directly over the storeroom which was used as a coat room by the girls in the office. One sprinkler head operated and completely extinguished the fire. Water from the sprinkler ran through the floor and was not discovered by the watchman until there was a large amount of water in a small space in the basement used for the storage of yarns. The fire damage did not exceed $2.00 but the water damage to the yarn in the basement was estimated at $5,000 to $6,000.

This fire very clearly illustrates the need of a sprinkler alarm in many installations. Had there been such an alarm, it seems reasonable to believe that the loss from water damage would have been comparatively small.

Watchman.

S-19283. Printing Shop. Fire started in a medium sized clothes locker containing workmen's overalls, and burned the top and doors of locker so that a large volume of heated air and flames was carried by the draft of elevator shaft to the ceiling, causing sixty-four sprinklers on this floor to open. Fire occurred at 8.30 P. M. on a Saturday night while watchman was on duty, but he did not investigate the cause for the ringing of the alarm bells. Two employees heard the alarm bells and on investigation found the fire on the second floor. The blaze was held in check by the sprinklers until the fire department arrived and used one line of hose.

A watchman who has not been properly instructed as to the duties of his position is of doubtful value.

Water Loss.

S-19176. Knitting Mill — Finishing Department. Fire was probably caused by a short circuit in the electric wiring of a neck marking machine. On examination it was found that some of the metal was fused, and undoubtedly sparks ignited the lint around the machine. Seven sprinklers operated and entirely extinguished the fire; however, considerable water was discharged, a large part of which ran through into the floors below, wetting the belts and sewing machines, also the stock

in these rooms. This stock was badly damaged, largely on account of the rusty water from the sprinklers. A loss of from $8,000 to $10,000 was incurred.

The probabilities of a heavy water loss in plants of this kind can be greatly lessened by insisting upon water-tight floors with scuppers.

Fire Doors.

S-19289. Linoleum Works. A satisfactory feature of this fire was the service of the fire doors. Near the roof at one end of the building were two 4 x 18-foot openings which were protected by steel curtain doors. These doors were slightly injured but can be easily repaired. They effectively prevented the fire from extending to the adjoining building. The doors undoubtedly became very hot as the radiation on the opposite side was sufficient to open fourteen of the 286 degree sprinkler heads located there. Had any of the doors in the various walls been left open, one of them might have failed to operate, in which case the loss would undoubtedly have been twice as great, at least.

It is better to keep automatic doors closed whenever possible to do so.

Water Curtain.

H-11698. This fire which occurred in a wooden furniture warehouse made rapid headway and was coming through the doors and windows when the firemen arrived. The main plant which was of brick construction was located only twenty-five feet away and was exposed very severely. The windows in the facing walls of the portions of the main plant nearest the warehouse were protected by outside sprinklers, all of which were immediately opened. These sprinklers were located at the two top floors but the water curtain formed by their discharge protected the windows below, although the heat was so severe that much of the water was evaporated before it reached the ground. The protection provided by this water curtain was very efficient since there was not a single head opened in the inside of the building despite the extremely severe exposure. The only damage to the main plant was from the slight amount of water which came through from the water curtain.

Miscellaneous.

H-11444. This building was used by a firm which treated old motion picture films in a solution which removed the gelatine containing the picture from the film. The fire was a very severe one due to the contents of the building and resulted in practically a total loss. A particularly interesting fact is that the chief of the fire department did not have any knowledge as to the hazardous business being conducted within the building. It was surrounded on all sides by dwelling houses and apartment houses.

The wisdom of an ordinance requiring an occupancy license is apparent in a situation of this kind.

H-11607. The burned area in this fire consisted of a group of poorly constructed buildings, one and two stories in height. The fire was promptly discovered and alarm sent in. Twelve minutes was consumed in attaching its hose, by the first company to arrive and by that time the fire had gained great headway. It is also said that the fire could have been controlled at this stage had the firemen entered the building and fought it at close range. Instead, they remained outside at the front of the building and apparently directed the streams in a most inefficient manner.

This was the first large fire which had occurred since a new city administration demoralized a very efficient fire department by dismissing about one-half of its experienced members, including the chief and two captains, and supplying in their places political men having no fire fighting experience. This lack of experience and discipline was very noticeable throughout every stage of the fire and was very largely the cause of the heavy loss. The loss would probably have been much greater if some of the previously discharged firemen had not volunteered their services when it was realized that the entire block was in danger.

Successful fire fighting is a business in itself, and a successful fireman must serve an apprenticeship, the same as would be necessary in any other business. The frequent mistake of bringing politics into the fire department is a costly one for any community.

H-9897. This building was used as a barn by a large teaming company and was of steel frame, fireproofed with clay tile and concrete. The floors, beams and fire walls were of reinforced concrete, and the curtain walls of brick. The building was 346 feet deep, 250 feet front, three stories in height, and had a concrete walled shaft about fifty by fifty feet in the center, and two fire walled elevator shafts. Wagons were kept on the first floor, the horse barn was on the second, and the third floor was used for feed and general storage. At the time of the fire the third floor contained about 200 tons of baled hay and straw, fifteen tons of paper and about twenty-five tons of barrel heads and a small quantity of lumber, while at the far end of this floor were a number of wagons. On the second floor were 250 horses.

Fire was discovered in the early evening by the manager who found the hay in flames as he was passing through the barn. An alarm was immediately sent in, and fifteen men assisted in leading the horses out. Fire spread over the entire area covered by lumber and feed, and the heat was so intense over part of this area that the shock resulting from the sudden application of water, caused the clay tile between the roof beams and under the steel girders to pop off, and in a few places the concrete to fall away, exposing the steel bars at the bottom of the beams.

Damage to the building, which was confined to the roof, amounts to not over $200.00, including two skylights broken out by the fire department, and the greater part of this damage may be considered more in the light of depreciation, which was so slight that repairing will not be necessary. Although the feed on the third floor was saturated with water for twelve

hours, the ceiling, underneath which was whitewashed, was entirely dry and white, showing no signs of the water nor of the intensely hot fire which occurred on the opposite side of the concrete floor.

The horses were returned to their floor within two hours after the fire started, and there was no indication at any time of smoke or fire on the horse barn floor.

This fire was an admirable illustration of how successfully properties which are ordinarily considered very hazardous may be safeguarded by using a high grade of fire-resistive construction.

Fire Causes.

The fires here given are selected to illustrate defects, either of construction or superintendence, in the classes of property indicated.

An inspection of the many reports received by this Association has brought out the fact that there seem to be three special hazards which have come particularly to the front as a result of the war.

The first is that of spontaneous ignition in dye stuffs. The difficulty in obtaining dye stuffs from Germany has resulted in a number of firms engaging in the manufacture of this material in this country. Apparently their product has been less stable chemically than that formerly used and consequently seems to show a much greater tendency to ignite spontaneously. Many fires have been noted which were apparently due to this cause, particularly in the case of the sulphur black dyes.

Another source of a large number of fires is the oil used by metal workers for hardening or tempering steel products. Many firms have received orders for munitions or other products which they do not usually make, requiring a hardened or tempered steel. They have hastily installed large oil tanks in which the hot metal is quenched. In some instances the piping or methods of storing these oils have been at fault and have resulted in fires, while in quite a few other instances lack of experience has resulted in a fire due to overheating of the oil or by placing too hot a piece of metal in the oil tank. Either of these hazards can be properly safeguarded if careful thought is given to the matter.

The tremendous increase in the manufacture of powder, picric acid and other ingredients which compose the modern high explosive has resulted in a considerable loss of life together with a great deal of property damage. Although much can be done to safeguard the hazards of this particular business, it seems almost impossible to entirely prevent explosions and fires resulting from the manufacture of these products. However, it appears from our records that a considerable number of these fires have resulted from lack of sufficient experience on the part of the workmen

handling the products. They have not been instructed as to the proper procedure whenever conditions show that the apparatus is not working perfectly. For example, there have been fires in nitrating machines, or extractors, because the water cooling system did not work properly and allowed the product to reach a dangerous temperature. If the workmen had been properly instructed, they would have at once stopped the process or made every effort to bring the temperature back to normal.

H-11024. Smokeless Powder Factory. Some workmen were filling wood metal-lined bins with common powder which was to be dried. This powder, which had previously been treated with alcohol and ether, still contained considerable alcohol and ether vapor when it came into the dry house. The only apparent explanation of the fire was that the friction from the sliding grains generated sufficient static electricity to ignite these vapors which in turn set fire to the powder. The powder was brought into the dry house in canvas bags and poured into these bins from the bags. Several of the men who were working in the building were severely burned by the quick flash of fire.

H-11424. Chemical Works. The superintendent noticed that the temperature in the third or tri-nitrator containing dinitrotoluol which was passing through the third nitration was abnormally high. He immediately tested the outlet pipe in the circulating coil and found steam issuing. Realizing that there was a stoppage of some kind in the circulating coil, he left the room to send for a mechanic. Immediately thereafter he heard a dull roar, and the whole building was enveloped in a sheet of flame which soon subsided. An investigation developed the fact that the water had not been in circulation for some hours previous in any of the di-nitrators. Fortunately no one was injured by the mild explosion which took place.

H-11600. Picric Acid Works. The process employed in this building was known as the American Nitration Process. A solution known as sulphoriated phenol (one part carbolic acid phenol and four parts sulphuric acid) was stored in overhead lead-lined tanks outside of the building. The solution was drawn to wood lined measuring tanks in the building which contained approximately 1,444 gallons each. These tanks had sliding wood covers and were equipped with lead-covered mechanical stirrers and lead coils for either heating or cooling. Nitric acid in the proportion of one part nitric acid to three parts sulphoriated phenol was then slowly added. The temperature for the nitration was kept close to 110 degrees Centigrade by the use of these heating or cooling coils. It is claimed that during this process, if the solution becomes too hot or if acid is added too rapidly, heavy fumes are given off, probably nitrous oxide gas.

This fire occurred in the afternoon when a shift of the men had just taken place. Brown fumes began to issue from one of the tanks into which the nitric acid was being slowly added, and the workman had to move back from this tank. At about the same time flames burst from

the top of the tank and all the employees were quickly driven from the building before they had an opportunity to use any of the inside protection. Fire gained headway rapidly and the entire building, which was a small frame structure, was soon destroyed.

It is interesting to note that the wet picric acid crystals did not burn to any extent as some of these were found in the ruins.

H-11401. Machine Shop and Foundry. In the manufacture of steel shells they are heated to a high temperature in a fuel oil furnace and are then quenched in a tank of oil. In the case hardening building, where this fire occurred, an old tank several feet deep but containing only two feet of oil had been pressed into service for this quenching operation. No cooling system for the oil was provided but an attempt had been made to keep the temperature down by blowing in air from three or four outlets. The fire occurred while the shells were being put into the oil, and in all probability was caused by the heating of the oil to the flash point, due to the continual dumping of red hot shells into it.

S-19235. Woolen Mill. Fire occurred in a dryer which was being run on cotton dyed in the fibre with sulphur black. The fire was undoubtedly caused by spontaneous ignition of the sulphur dyed cotton.

Gasoline and Other Volatiles.

H-11566. Rubber Tire Manufacturing. Fire occurred in a building formerly used for reclaiming rubber from the factory scrap by means of an acid process. About one week before the fire the manufacture of an organic chemical known as thiocarbanilide was started in the east room of the building. This material is prepared by the reaction of carbon bisulphide on aniline oil and the process is carried on in closed metal tanks. After the reaction was completed the material, which consisted of a pasty mass, was put on the floor to dry. It is evident that an excess of carbon bisulphide was used in the reaction mixture and that the drying process consisted of an evaporation of this liquid.

On the day of the fire an employee struck one of the lumps of this material with an axe which caused the whole mass to burst into flames. It seems probable that the axe struck some metallic substance, causing a spark which ignited the carbon bisulphide vapor, as some of this material had evidently remained in the mass. On account of the bisulphide present in the room the fire spread very rapidly. The roof of the building and the window and door frames were practically all destroyed. The walls, which were of tile, were somewhat damaged.

The lesson from this fire is that such a hazardous process should not be conducted in an unsprinklered building containing as much value as the one in question, even though the building is comparatively small and detached. A safer method should also be used in breaking up the lumps of this thiocarbanilide, since in the presence of carbon bisulphide the smallest spark or even severe friction is almost sure to result in a fire.

The main portion of the plant was equipped with automatic sprinklers

but was not threatened seriously by the fire in this unsprinklered building. Loss amounted to $10,000.

S-18647. Varnish Works. Chemist was mixing a floor wax in a steam jacketed copper kettle in which considerable turpentine was mixed with paraffin at a temperature of about 130 degrees F. He was delayed in completing his work so that it became dark and he attempted to turn on the lights. The lamp over the kettle about three feet above was burned out, and without opening the main switch the man attempted to insert a new lamp. A spark in the socket ignited the turpentine fumes over the kettle. The fire was controlled, with but a small loss, by the prompt operation of the sprinklers.

H-11487. One of the tenants of this building found an intoxicated man sleeping in the basement on some old mattresses. As a joke, he poured some alcohol on the trousers of the man and ignited this. The alcohol created more of a blaze than was expected and in trying to prevent the man from being burned to death the fire in the basement was neglected and not reported until it had obtained such a good start that it was beyond control. The fire completely destroyed the building with the exception of the front wall. A large frame, shingle roof, livery barn situated about thirty feet away was also destroyed.

A conflagration would probably have resulted had it not been for the fact that most of the shingle roofs in the vicinity were covered with snow and ice, and the firebrands falling on them were extinguished. The loss resulting from this act was $79,628.

H-11664. Dry Cleaning Establishment. Benzine washing was carried on in the extreme end of the building, cut off from the front portion. Adjoining the washroom was a vacant building. A bricklayer was sent to make repairs in this vacant building and as he entered and lighted a match, an explosion occurred. He was severely burned.

S-19040. Garage. An employee was cleaning a detached automobile motor with gasoline when another employee accidentally touched the motor with a wire from battery, causing a spark which ignited the gasoline. One sprinkler head operated and extinguished the fire before the arrival of the department.

Spontaneous Ignition.

S-18435. Manufacturing Advertising Novelties. Fire was due to spontaneous combustion in a stock of flags or pennants, caused by oxidation of the heavy linseed oil paint used in lettering them and which apparently was not thoroughly dry. The prompt operation of the sprinklers prevented a serious loss.

S-19258. Fire was caused by spontaneous ignition in linseed oil-soaked sawdust which had been deposited in a rubbish barrel, the latter not having been removed from the premises as usual that night. The prompt operation of the sprinkler system gave the alarm and extinguished the fire with a very slight loss.

S-19122. Machine Shop. This fire occurred in oily steel scrap. The cause was very probably due to spontaneous combustion.

The lesson to be learned from this fire is that all oily steel scrap should be removed from the main building and deposited at a distance.

Motion Picture Films.

H-11662. Film Exchange. A film was being run through a test machine which was driven by an open brush motor controlled by a knife switch. It is believed that a flash from this switch when it was pulled open ignited the film. The test machine was just outside the vault door, which was open. Fire was immediately transmitted to the large amount of stock in the vault and it spread from there, so that the whole building was destroyed. The loss was a heavy one.

There are several recommendations which suggest themselves in connection with this fire. These are all contained in this Association's Suggestions for the Storing and Handling of films.

H-11676. Express Car. This express car was completely destroyed together with its contents, including several thousand dollars in coin which was melted. Fire broke out at 2.45 A. M. while the train was in motion. The car had no end doors, and the express messenger and his helper had a very narrow escape from death. They escaped by clinging to the iron ladder at the side door where they rode for seven miles at high speed before the conductor in the rear baggage car discovered the fire and stopped the train. The burning car was side-tracked and the balance of the train saved. Loss estimated at $50,000.

According to the story of the express messenger's assistant, they were busy calling off the freight and piling it near the radiator at the side of the head end of the car when he was attracted by a dull hissing sound. He then saw a cloud of white smoke which he thought was steam coming from a broken pipe in the radiator. He rushed to the radiator to shut off the steam, when a sheet of flame burst from the pile of freight into his face and swept the car to the rear side door from which they made their escape. It was impossible to reach the conductor's valve to the air brake on account of the fire, and even if there had been no fire they could not have reached this air brake because of the freight piled to the ceiling. While the messenger claimed to notice only two boxes of moving picture films, the number of metal parts recovered from the fire seemed to indicate that the car contained a larger number of films, which were either overlooked by the messenger or else were not properly marked with the yellow label required by the Interstate Commerce Commission.

It could not be definitely determined that the films were directly responsible for the fire but it is certain that their presence materially assisted in its rapid spread.

S-18587. Fire occurred on the third floor of this building occupied by a film service house. Employee was operating a motion picture

machine in a tile enclosed booth having automatic metal slides (strip suspended) and a self-closing tinclad door. His attention was momentarily attracted by another employee who put three reels of film on the floor just inside the door of the booth, and in the meantime the film in the machine became doubled and prevented the closing of the automatic shutter on the machine. The film became ignited and the flames spread to the other three reels in the booth. One sprinkler head opened and extinguished the blaze before the arrival of the fire department. Employee operating the machine shut off electric current and left booth as soon as the first film became ignited. The shutters on the walls of the booth closed automatically. There was no loss except to the reels of film.

Miscellaneous.

S-19115. Cotton Mill. An electrician employed by an outside contracting firm was engaged Saturday afternoon in making some repairs to the wiring of the electrical engine stop. Contrary to the usual custom there was no one connected with the mill overlooking his work. He found it necessary to go into the pit of the fly wheel in the engine house, and as the place was dark he used a lighted candle although good portable electric lights were available. The candle flame came in contact with the lint which had accumulated and there was a quick puff of fire, described as a mild explosion, which spread through the wooden casing around the fly wheel and up into the belt tower. The four main belts were badly burned and the wooden rim of the fly wheel was burned so that it was useless. The majority of the sprinklers in the belt tower opened. They prevented the fire from making much headway in the tower itself, although there were a few places where the floor, being sheltered from the action of the sprinklers, was burned. There was considerable water damage to the card clothing as thirty-four cards were wet down. The loss amounted approximately to $15,000.

Fires starting from carelessness with a candle or open torch in the fly wheel pit seem to occur quite frequently and almost invariably result in a considerable loss.

H-11442. Pyroxylin plastic was packed for export in tin-lined cases which were taken to the platform outside the building, where tin covers were soldered on. A mistake was made in packing one of the cases and it was necessary to open the case. It was taken to the platform where the workman used a soldering iron to open a seam in the tin cover. This ignited the contents.

S-19313. Theatre. This fire was caused by a lighted candle, which was being used by one of the actors for softening makeup, coming in contact with light inflammable costumes hanging on the wall. One sprinkler opened and extinguished the fire.

H-11461. This fire occurred in a one-story frame transformer air compressor house. The air compressors consisted of a single stage 9 x 10-

inch machine driven by a 20 H. P. motor, and a two stage Ingersol Rand 19 x 16 inch and 12 x 16 inch compressor driven by a 100 H. P. motor. The governors of the compressors were set at eighty pounds. As near as can be ascertained, the governor on the large compressor failed to operate at eighty pounds. The pressure kept increasing until it reached 100 pounds, when the safety valve opened. The compressor kept pumping air into the tank and out through the safety valve. This continuous process caused the tank and connections to become considerably overheated and the tank was so hot thirty minutes after being shut down that the hand could not be held against it. A quantity of clean dry cotton waste on the shelves near the tank came in contact with it and took fire. The fire itself was promptly discovered and practically no damage resulted.

S-19089. Rubber Fabric Factory. Fire occurred in a spreading machine at 5.30 P. M., probably caused by static electricity. At 11.15 the following morning another fire occurred in the same machine. The employee was pouring a thin cement from a dipper on the fabric in front of the knife. A spark passed from the metal dipper to the grounded machine, igniting the benzine from the cement. The fire was extinguished by a chemical extinguisher and three sprinkler heads located under the machine hood. In each fire a few yards of the spread fabric was destroyed.

The three sprinklers located in the room where fire occurred are well arranged and protected. The cloth drags on the grounded metal steam table so that an electric charge is prevented from accumulating on the goods while over the table. A charge accumulates to some extent on the roll of cloth, both under the machine and at the front when it is drawn back for recoating.

At the time of this visit the weather was cold and the relative humidity of the room was from twenty-seven per cent to thirty per cent. Sufficient static electricity could be collected by placing one's hand near the cloth being rolled up under one of the smaller machines to produce a sharp spark when the finger was brought near the grounded machine. The speed of the machine is an important factor in the accumulation of an electric charge. The electric static capacity of the attendant's body was the cause of one of the fires and is the most common cause of fires about spreaders. Grounding the machine or shafts cannot destroy this charge, and to permanently ground the attendant is impracticable. The most efficient method of preventing spreader fires is to maintain a relative humidity in the spreading room sufficiently high to prevent the accumulation of an electric charge. Forty to fifty per cent will probably be found sufficient under ordinary conditions.